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ABSTRACT

The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the waste water treatment mechanics occupation. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Twelve duties are broken down into a number of tasks and for each task a two-page table is presented, showing on the first page: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety--hazard; and on the second page: science; math--number systems; and communications (performance modes, examples, and skills and concepts). The duties include performance of: screenings and comminuting; grit removal; pumping; flow measurement; pretreatment by chemical addition; coagulation and flocculation; sedimentation; sludge wasting and digestion; biological decomposition via activated sludge, trickling filters, and oxidation lagoons; and chlorination. The document concludes with three appendixes covering work attitudes and desirable personal characteristics, a list of standard tools, and 40 pages of items used in wastewater treatment. (BP)

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Occupational Analysis

CE004267

WASTE WATER TREATMENT MAINTENANCE MECHANIC

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Instructional Materials Laboratory
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AN ANALYSIS OF THE WASTE WATER TREATMENT MECHANIC OCCUPATION

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FOREWORD

The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics, and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one involved the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of conducting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis inlcuded a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills of mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures, as well as identifying specific supporting skills and knowledge in the academic subject areas.

PREFACE

Purpose: The purpose of this document is to develop rudimentary occupational job analysis for:

1. Wastewater treatment operators (without supervisory duties)
2. Wastewater treatment maintenance mechanics

Scope: These occupational job analyses cover all commonly used individual steps and and processes required for pretreatment, primary, and secondary treatment of municipal wastewaters

Depth: Each major piece of equipment or general grouping (with respect to a specific process) is examined with respect to:

1. operational requirements,
2. maintenance requirements, and
3. sampling, analyzing and performance evaluation

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JOB DESCRIPTION

Under supervision, performs any combination of the following duties pertinent to maintaining the operation of the plant:

1. Performs preventive maintenance and repairs on screening and/or comminuting devices, grit removal equipment, a variety of pumps, flow recorders, chemical addition devices, sedimentation tanks, sludge wasting and digestion equipment, activated (aerated) sludge systems, trickling filters, oxidation lagoons/ponds, and disinfection equipment.

2. Monitors records and reports – results of routine maintenance inspections and repair work.

Note: These job descriptions are only for the duties and tasks examined and do not include any extraneous activities.

Duty A Performing Screenings and Comminuting

1. Maintain screening and comminuting equipment

(TASK STATEMENT) MAINTAIN SCREENING AND COMMINUTING EQUIPMENT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Coarse screen – hand cleaned Coarse screen – mechanically cleaned Comminutor Valves, Hook, shovel, hoses, squeegee, Standard Mechanic Tool Kit, hard hats, cable hoist, chain hoist, jacks, pry and spud bars, plumb level, three-fourths drive, socket set, drop lites, rope, chain, equipment drawing and parts books, boots, drift pins, safety–danger men working tag for switch gear, large wrenches Electric drill Steam jenney Acetylene welding torch	Perform preventive maintenance per Plant Maintenance Manual Identify malfunction Determine and report cause of malfunction Obtain parts and instructions necessary for repairs Repair or replace defective parts Test equipment for satisfactory repair Enter repairs on maintenance record cards	Handling mercury from comminutor seal – avoid contact from fumes or liquid mercury Infection by contact with or ingestion of pathogens Keep ventilation fans on Asphyxiation by toxic gases Suffocation from oxygen deficiency Explosion or fire from flammable solvents Pinched against moving machinery – guards Slipping on slippery surfaces – housekeeping, rubber mats, skid-proof surfaces Back strain through improper lifting – proper lifting techniques Electrical shock from improperly grounded electrical equipment – ground rubber mats Electrical shock – lock out equipment before working on it

DECISIONS	CUES	ERRORS
Decide if maintenance schedule should be changed based on operating experience of equipment Determine if operator correctly identified malfunction Determine whether to repair other worn parts which are still servicable or return to service	Preventive maintenance schedule Operator report Other worn parts	Early breakdown Replace wrong part

(TASK STATEMENT) MAINTAIN SCREENING AND COMMINUTING EQUIPMENT

SCIENCE	MATH – NUMBER SYSTEMS
Behavioral science (see appendix) Simple machines used to gain mechanical advantage. [tools, moving parts] Resistance of materials to change in shape [straightening parts] Effect of heating and cooling on expansion of materials [removal of gears, sleeves]	Rational numbers Fundamental operations (calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., use of parentheses in simplifying arithmetic expressions Basic arithmetic skills and concepts – changing fractions to decimals and decimals to fractions; ratio and proportion; estimation ; property of comparison – equality/equivalence, inequality/greater than/less than Instruments: Measurement: geometric – linear ; measurement: non-geometric – time, and speed; read and interpret tables, charts and graphs – scale drawings/floor plans/blueprints Knowledge of geometric relationships – parallel and perpendicular

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Comprehension, description of mechanism, and process report – instructions
Writing		Memo format, description terminology/general vocabulary, and clarity of expression
Listening		Discriminate facts from non-facts, noise discrimination (recognize proper and improper sounds; animal, human, and machine)
Viewing		Visual analysis , memory, describing, and recognition of symbols, codes, and emblems
Touching		Temperature, texture, vibration
Smelling		Odors

Duty B Performing Grit Removal

1. Maintain and repair hand cleaned grit chamber
2. Maintain mechanically cleaned grit chamber

(TASK STATEMENT) MAINTAIN AND REPAIR HAND CLEANED GRIT CHAMBER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard Mechanics Hand Tool Kit Large pipe wrenches Grease gun Wet suit Grease Repair parts Grit removal tank Valves Gates	Grease valve gate slide channels Grease or pack valve stem gear box Repack drain valve Reface or replace drain valve face or valve seat Record and report result	Proper lifting procedures Proper footing surfaces Personal hygiene Head injuries Strained muscles Falls Infection by contact with or ingestion of pathogens
DECISIONS	**CUES**	**ERRORS**
Determine whether to repair or not repair	Is valve operation too difficult Does valve seal properly	Frozen valves result in broken valve stems or stripped gears Leaking valves result in failure of valve seats on drain valve and excess corrosion

(TASK STATEMENT) MAINTAIN AND REPAIR HAND CLEANED GRIT CHAMBER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [mechanical advantages gained from use of simple hand tools] Relationship of force to distortion in an elastic body [distortion of gaskets caused by improper tightening] Resistance of materials to change in shape [excess pressure applied to any unit will result in permanent distortion or breakage of the unit] Behavioral science (see appendix)	Set of real numbers [positive rationals] Irrationals/rationals Fractions/decimals Integers Whole numbers Counting Fundamental operations (calculation) Addition algorithm Subtraction algorithm Basic measurement skills and concepts Measurement: geometric linear

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Follow instruction sheet	Comprehension, description of machinery, instructions
Listening	Analyzing machinery noise	Noise discrimination
Viewing		Visual analysis (seeing the parts in relation to the whole), memory (short and long term retention), describing (discrimination and verbalization of physical characteristics), logic (ordering of thoughts and perceptions), detail and inference, color discrimination, and recognition of symbols, codes, and emblems

(TASK STATEMENT) MAINTAIN MECHANICALLY CLEANED GRIT CHAMBER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance machanics hand tool kit Brush Hoses, ladders, and boots, rubber gloves Hard hat Special wrenches Welding equipment Hoists Jacks Cutting equipment Blocking materials Wet suit Maintenance manuals Blue prints Repair parts (chain links, flights, bearings, shear pins, grease, oil, etc.) Mechanical grit removal equipment supplied to individual installation	Major preventative maintenance (scheduled) Scheduled changes of oil and grease in gear boxes Enter maintenance performed on record cards Major corrective maintenance (equipment failure unscheduled) Determine and report cause of malfunction Obtain instructions and necessary parts for repair of malfunction Disassemble, repair and reassemble malfunctioning unit Start up and check newly repaired unit for proper operation Enter repairs made on record cards	Good footing Beware of moving parts Personal hygiene Hard helmet (close quarters) Falls Injuries to extremities Infections Head injuries

DECISIONS	CUES	ERRORS
Determine whether to perform or delay scheduled maintenance, based on time and materials available Determine whether to follow maintenance recording procedure Determine whether task must be done immediately or may it be postponed to later date Determine whether to remove foreign objects, then determine if any further repairs are needed Determine whether to read, understand, and follow manufacturer's maintenance manual Determine whether to follow standard maintenance (all repairs must be checked)	Maintenance schedule Standard plant maintenance procedure Equipment stalled or operator's complaint Standard maintenance procedure Manufacturer's maintenance manual	Bearing or gear box failure due to lack of lubrication or freezing of condensate in cold weather May miss or unnecessarily repeat a scheduled maintenance operation Postponement may result in increased damage and complete equipment failure Unnecessary waste of mechanic or operator's time and excessive replacement parts cost Lack of performance history of unit

(TASK STATEMENT) MAINTAIN MECHANICALLY CLEANED GRIT CHAMBER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [use of tools] Effect of heating and cooling on state of matter [reason for seasonal lubrication change] Fluids under pressure [lubrication gear boxes] Centrifugal forces developed by bodies in rotation [cyclone grit washer] Effects of friction on work processes and product quality [slip clutch failure, bearing failure] Relationship of force to distortion in an elastic body [gasket failure, chain tightening] Resistance of materials to change in shape [twisted shafts] Behavioral science (see appendix)	Set of real numbers –positive rationals –– irrationals/rationals, fractions/decimals, integers, whole numbers, counting Fundamental operations (calculation) – addition and subtraction algorithms Changing fractions to decimals and decimals to fractions Rounding off decimals and whole numbers "Measure sense"/role of "unit" Instruments: Measurement: geometric – linear Measurement: non-geometric – speed (example: feet per minute, R.P.M.) Read and interpret tables, charts, and graphs – scale drawings/floor plans/blueprints

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary, appropriate diction, clarity of expression, and usage
Reading		Comprehension, detail/inference, informational reports, recommendation reports, description of mechanism, process report–instructions
Writing		Reports (work reports)
Listening		Auditory discrimination, recognize opinions; concentration, and noise discrimination (recognize proper and improper sounds; animal, human, and machine)
Viewing		Visual analysis, memory, describing, logic, detail and inference, color discrimination, and recognition of symbols, codes, and emblems
Touching		Size, shape, texture, motion, temperature, tissue

Duty C Performing Pumping

1. Maintain centrifugal and positive displacement pumps

(TASK STATEMENT) MAINTAIN CENTRIFUGAL AND POSITIVE DISPLACEMENT PUMPS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics hand tool kit Pump switch, lockout tag, boots, gloves, hoses, hoist, cable chain, rope, ladder, large wrenches, pinch bar, jack, plumb level, packing tools, electrical continuity tester Portable pump, steam jenney, drift pins, pump manual, control system manual . Gaskets, bearings, packing, lubricants, floats, diaphragms, solenoids, fuses, belts, couplings, pump parts Pumps, level controller, check gate and plug valves	Perform preventive maintenance per Plant Maintenance Manual Identify malfunction Determine and report cause of malfunction Disassemble and determine repair or replacement parts required Obtain parts and instructions for repairs Reassemble and test for normal operation Enter repairs on maintenance record cards	Infection by contact with or ingestion of pathogens – innoculation, personal hygiene Keep ventilation fans on Asphyxiation by toxic gases Suffocation from oxygen deficiency Explosion or fire from flammable solvents Pinched against moving machinery Slipping on slippery surfaces –housekeeping, skid-proof surface Back strain through improper lifting Electrical shock from improperly grounded equipment – ground equipment

DECISIONS	CUES	ERRORS
Determine type of malfunction Correct malfunction on location or remove and take to repair shop Determine if assembled wrong	Blown fuses; switch contacts–corroded or dirty; terminal connections loose or broken; level control mechanism malfunctioning; motor shorted or burned out Incorrect impeller adjustment; impeller damaged; packing worn or defective; impeller turning on shaft; broken flexible coupling; air leak in suction line; check valve – stuck or clogged; wearing rings worn or binding ; worn or binding impeller Does not operate properly	Increased cost and increased down time if wrong method of repair is chosen Reverse electrical leads, misalligned – put together wrong, wrong clearances

(TASK STATEMENT) MAINTAIN CENTRIFUGAL AND POSITIVE DISPLACEMENT PUMPS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [simple tools] Effect of heating and cooling on expansion of materials [binding due to overheating] Effect of heating and cooling on state of matter [vapor lock in pump] Fluids under pressure [incompressable fluids – sewage] Centrifugal forces developed by bodies in rotation [pump] Forces acting on a body immersed or floating in a liquid [floats on level control] Transfer of energy from one form to another [fluid flow] Resistance of materials to change in shape [shafts, couplings, V-belts] Behavioral science (see appendix)	Positive rational numbers Changing mixed numbers to improper fractions Ratio and proportion; estimation Property of comparison – equality/equivalence, inequality/greater than/less than [bearing shaft tolerances] "Measure sense"/role of "unit" Instruments: clearances, bearing sizes, pumping rates, and alignment Given an instrument of measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance Metric and English measure and conversion; rate Measurement: geometric – linear, area, volume, and angle Measurement: non-geometric – temperature and speed Read and interpret tables, charts and graphs: scale drawings/floor plans blueprints [pump prints]; representational graphs [pump performance curve] Recognize and identify basic geometry figures, plane and solid; knowledge: symmetry, congruence, similarity, parallel, perpendicular, skew

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Comprehension, process report – instructions
Writing		Memo format
Listening		Noise discrimination (recognize proper and improper sounds; animal, human, machine)
Viewing		Visual analysis, describing, color discrimination, and recognition of symbols, codes, emblems
Touching		Temperature, texture, motion-vibration, and pressure
Smelling		Odor – burning, overheating:electric or pump

Duty D Performing Flow Measurement

1. Maintain flow measurement devices

(TASK STATEMENT) MAINTAIN FLOW MEASUREMENT DEVICES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard Mechanic Tool Kit, jeweler's screwdrivers, instrument wrenches, volt-ohm-ampere meter, pipe threaders, pipe cutters, flaring tool Adjustment nut sealer, detergent and water, spare parts, organic solvents, and oil Constant differential rotameters, weirs—rectangular, v-notch, cipolletti, sutro, flumes-Parshall, Palmer-Bowlus, nozzle, velocity meters – propeller, shunt flow, magnetic meters, displacement meters, transmitting and recording devices, valves	Perform preventive maintenance per Instrument Maintenance Manuals Identify malfunction Determine and report cause of malfunction Obtain parts and instructions necessary for repair Test equipment for satisfactory repair Enter repairs on maintenance record cards	Slipping on slippery surface – housekeeping skid-proof surface Electrical shock – lock out power source Ventilation in closed areas required to prevent asphyxiation or suffocation Keep ventilating fans on Infections by contact with or ingestion of pathogens

DECISIONS	CUES	ERRORS
Determine whether to clean sensing devices Determine whether to disassemble, clean tube and float Determine whether to clean or replace and lubricate Determine whether to check vapor seals, heater or dessicant Determine whether to troubleshoot system (sensory transmitter, recorder) Determine whether to call experienced instrument repair person Determine whether to follow repair manual	Accumulation of foreign bodies in stilling well, orifices venturi tubes, nozzles, pneumatic tubes Dirty rotameter Corroded cable Wrinkled chart, condensation Erratic or erroneous readings Equipment damaged during repairs	Inaccurate readings Attempting major service may cause equipment damage Improper repairs may cause equipment damage

(TASK STATEMENT) MAINTAIN FLOW MEASUREMENT DEVICES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools, linkage, and pulleys] Magnetic fields of force [magnetic flow meter] Fluids under pressure [bellows, bubbler tubes, pressure sensors] Forces acting on a body immersed or floating in a liquid [floats, bubbler tubes] Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation): Addition, subtraction, multiplication, and division algorithms, and order of operations, i.e., use of parentheses in simplifying arithmetic expressions Basic arithmetic skills and concepts: Ratio and proportion – estimation Basic measurement skills and concepts: Instruments: ruler, meter scales Metric and English measure and conversion Rate: sensors and receivers Measurement: geometric – angle Measurement: non-geometric – weight, liquid, speed [meters] Read and interpret tables, charts, and graphs [charts, graphs, tables] Manipulation of formulae [flow and weir formulas]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Comprehension, description of mechanism, and process report – instructions
Writing		Memo format
Listening		Noise discrimination (recognize proper and improper sounds: animal, human, machine
Viewing	(must interpret electrical and piping systems and relate to instruction manual)	Visual analysis, describing, color discrimination, recognition of symbols, codes, and emblems
Touching		Motion vibration, texture, temperature, pressure (works on small fragile parts)

Duty E Performing Pretreatment by Chemical Addition

1. Maintain pretreatment units (chemical additions)

(TASK STATEMENT) MAINTAIN PRETREATMENT UNITS (CHEMICAL ADDITIONS)

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics hand tool kit Calipers Tape Micrometers Volt-ohm-ampere meter Pipe reamer Gaskets Packing Lubricants Spare parts Fuses Chemical feeders (wet and dry) Chemical storage and transport system Mixing tanks (flash and slow mix) Measuring devices – weight and volume Dust collectors Chemical additions control Rubber gloves	Perform preventive maintenance per Plant Maintenance Manual Identify, determine, and report cause of malfunction Obtain instructions and parts necessary for repair Disassemble, make repair, and reassemble machinery Start up and check for normal operation Enter repairs on maintenance record cards or log	Dust mask for loading and unloading of hazardous chemicals Slipping on slippery surfaces – housekeeping skid-proof surfaces Chemical burns on cuts Eye protection (shields – glasses) when loading or unloading hazardous chemicals Ferric chloride,liquid alum – rubber aprons, knee boots, and eye protection Chemical dust and fume exhause system Positive ventilation

DECISIONS	CUES	ERRORS
Determine whether to check and adjust controls and drive mechanisms Determine whether to troubleshoot electrical and mechanical systems Determine whether to troubleshoot chemical feed control systems Determine whether to remove blockage, check for proper mixing, and proper velocity through lines	Erratic operation of chemical feed mechanisms Thermal or electrical overload Erratic sensing, transmitting and recording mechanisms Blockage in pipe lines – line caking	Overfeed or underfeed Equipment failure Improper feed Increase downtime for cleaning and repair

(TASK STATEMENT) MAINTAIN PRETREATMENT UNITS (CHEMICAL ADDITIONS)

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [simple tools] Work input, work output, friction and efficiency in simple machines [conveyors, drive systems] Effect of heating and cooling on expansion of materials [keeping chemicals in solution] Fluids under pressure [hydrostatic head] Resistance of materials to change in shape [twisting, bending, stretching of structural members] Deterioration of metals due to corrosion Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation) – addition, subtraction, multiplication, and division algorithms, and order of operations, i.e., use of parentheses in simplifying arithmetic expressions Ratio and proportion – estimation Instruments: thermometer, ruler, tape, caliper, tachometer, micrometer Rate [rate of chemical addition, flow] Measurement: geometric – volume [vessels, bins] Measurement: non-geometric – temperature, weight, liquid, dry, and speed (example: feet per minute, R.P.M., etc.) Conversion from one standard unit to another [tons, pounds, English to metric] Read and interpret tables, charts, and graphs – scale drawings/floor plans/blueprints Basic geometry skills and concepts: Use of variables: for stating axioms, and as parameters [alignment]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Smelling Writing Listening Viewing		Terminology/general vocabulary Temperature, texture, motion-vibration, pressure Comprehension, process report – instructions Odors Memo format Auditory discrimination, and noise discrimination (recognize proper and improper sounds: animal, human, and machine) Visual analysis (seeing the parts in relation to the whole), describing (discrimination and verbalization of physical characteristics), color discrimination, and recognition of symbols, codes, and emblems

Duty F Performing Coagulation and Flocculation

1. Maintain coagulation and flocculation units

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(TASK STATEMENT) MAINTAIN COAGULATION AND FLOCCULATION UNITS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics hand tool kit Calipers Tape Micrometers Hoist Chain Blocking Hydraulic jack Volt-ohm-ampere meter Crane Acetylene cutting torch Gaskets Packing Lubricants Fuses Coagulation and flocculation tanks Valves Plungers Paddle wheels, variable speed, and drive units	Perform preventative maintenance per Plant Maintenance Manual Identify, determine and report cause of malfunction Obtain instructions and parts necessary for repair Disassemble, make repairs, and reassemble machinery Start up and check for normal operation Enter repairs on maintenance record cards	Slipping on slippery surfaces – good housekeeping–skid proof surfaces Falling into tank – surefootedness Pinched between moving machinery – keep guards in place – lockout equipment before working on it

DECISIONS	CUES	ERRORS
Determine whether to shut off unit and repair	Broken paddle Broken rocker arm Broken plunger Broken chain Broken shaft	Seriously damaged equipment; poor treatment

(TASK STATEMENT) MAINTAIN COAGULATION AND FLOCCULATION UNITS

SCIENCE	MATH -- NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [simple tools] Resistance of materials to change in shape [twisting, bending, stretching of structural members] Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation): addition, subtraction, multiplication, and division algorithms, and order of operations, i.e., use of parentheses in simplifying arithmetic expressions Ratio and proportion -- estimation [variable speed drive] Instruments: ruler, tape, caliper, tachometer, micrometer Rate [drive units] Measurement: geometric -- volume [tank] Measurement: non-geometric -- liquid, dry [drives] Read and interpret tables, charts, and graphs -- scale drawings Basic algebra skills and concepts: use of variables in formulae [drive ratios] Basic geometry skills and concepts: knowledge of geometric relationships-parallel, and perpendicular [alignment]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Comprehension
Writing		Memo format
Listening		Auditory discrimination, and noise discrimination (recognize proper and improper sounds: animal, human, and machine)
Viewing		Visual analysis (seeing the parts in relation to the whole), describing (discrimination and verbalization of physical characteristics), and recognition of symbols, codes, and emblems
Touching		Temperature, texture, motion-vibration, and pressure
Smelling		Odor

Duty G Performing Sedimentation (Primary and Secondary Solids Removal)

1. Maintain mechanically cleaned settling tanks
2. Maintain Imhoff settling tanks

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(TASK STATEMENT) MAINTAIN MECHANICALLY CLEANED SETTLING TANKS

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TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Sludge collection equipment Scum collecting equipment Drive unit weirs Standard maintenance mechanics hand tool kit Voltage tester, electrical continuity tester, brush, hoses, squeeges, ladders, boots Repair parts (wooden flights, wearing shoes, chains, blades, squeegee, couplings, shear pins, gears), paint Plant Maintenance Manual Equipment drawing and parts books Hoist Jacks Air hammer Air compressor Acetylene and electric welding, and cutting equipment Drift pins, wedges, blocking Painting equipment	Perform preventive maintenance per Plant Maintenance Manual Identify malfunction Determine and report cause of malfunction Obtain instructions and parts necessarey for repair Disassemble, make repairs, and reassemble machinery Start up and check for normal operation Enter repairs on maintenance record cards Check and properly set torque overload warning and protective devices	Slipping on slippery surfaces – clean up oil, grease, watch footing Infection by contact with or ingestion of pathogens – wash hands before eating or smoking; hands below collar while working; prompt first aid for all minor cuts; prompt medical attention to all major cuts and puncture wounds Falling into tank – watch footing Tie off ladders in tanks – falls

DECISIONS	CUES	ERRORS
Determine whether to inspect collector, keep running, or dewater tank Determine whether to replace shear pin or reset overload and make further examinations Determine whether to dewater tank and replace broken parts Determine whether to replace sprocket Determine whether to remove object and determine if preventive replacement of other parts should be carried out while tank is out of service	Jerking, jumping, or stalled collector mechanism Broken shear pin or overload trips Broken chain link or broken flight Bad sprocket Rock or stick jammed in collector	Damage equipment, break shear pin Shear pin breaks or overload trips Damage more equipment, leave sludge in tanks Equipment out of service

(TASK STATEMENT) MAINTAIN MECHANICALLY CLEANED SETTLING TANKS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools] Work input, work output, friction and efficiency in simple machines [wear analysis] Motion resulting from two or more forces acting on a point in a body [jamming or blockage] Resistance of materials to change in shape [alignment, diagnosing cause of breakage] Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation) Addition, subtraction, multiplication, and division algorithms, and order of operations, i.e., use of parentheses in simplifying arithmetic expressions Changing fractions to decimals and decimals to fractions [converting rule measurement to decimal] Instruments: ruler, caliper, micrometer, and tachometer Measurement: geometric – linear [linear measurement] Measurement: non-geometric – speed [gear reduction] Read and interpret tables, charts, and graphs – scale drawings Basic geometry skills and concepts – knowledge of geometric relationships : parallel, and perpendicular [alignment] Property of comparison – equality/equivalence, and inequality/ greater than/less than

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading	Comprehending manuals	Comprehension, description of mechanism, and terminology
Writing	Memos, record cards	Memo format, description, terminology/general vocabulary, and clarity of expression
Listening		Discriminate facts from non-facts, and logic (ordering of thoughts and ideas)
Viewing		Visual analysis, memory, describing, detail inference, and recognition of symbols, codes, and emblems
Touching		Temperature, texture, motion-vibration, and pressure
Smelling		Odors–burning, noxious, hydrogen sulfide

(TASK STATEMENT) MAINTAIN IMHOFF SETTLING TANK 34

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics hand tool kit Hoses Saw Portable pump Hoist Jacks Blocking and cutting torch Lead pot Caulking Tools Plumbers lead Oakum Planking Paint Sludge draw-off line Guard rails Walkways	Inspect sludge draw-off line Determine cause of malfunction Connect pump and backflush sludge draw-off line with settled wastewater Repair defective grating (walkway) Repair or replace valves Paint equipment Report and record results	Falling into tank – watch footing and clean up grease Slipping on slippery surfaces Infection by contact with or ingestion of pathogens – wash hands before eating, smoking, etc., Innoculation Handling gasoline – use spring loaded can – do not refuel running engine
DECISIONS	**CUES**	**ERRORS**
Determine if backflush will remove debris Determine whether to replace or repair grating Determine whether to repair valve while tank is in service or dewater tank and replace valve	Blockage in line Hazardous or defective grating Valve will not open or close Valve stem broken	If not corrected promptly, line may have to be dismantled Increase chance of personal injury Increase time unit out of service

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(TASK STATEMENT) MAINTAIN IMHOFF SETTLING TANK

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [simple tools] Fluids under pressure Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation) Addition algorithm Subtraction algorithm Multiplication algorithm Division algorithm Order of operations, i.e., use of parentheses in simplifying arithmetic expressions Basic measurement skills and concepts – Measurement: geometric – linear, area, and volume Measurement: non-geometric – speed [dewatering tank]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Process report – instructions
Writing		Memo format
Listening		Noise discrimination (recognize proper and improper sounds; animal, human, machine)
Viewing		Visual analysis (seeing the parts in relation to the whole), describing (discrimination and verbalization of physical characteristics), memory (short and long term retention)
Touching		Motion–vibration, temperature

Duty H Performing Sludge Wasting and Digestion

1. Maintain sludge wasting equipment and aerobic digester
2. Maintain an anaerobic digester

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(TASK STATEMENT) MAINTAIN SLUDGE WASTING EQUIPMENT AND AEROBIC DIGESTER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics tool kit Gear puller Thirty-six inch pipe wrench Three-foot level Paint brushes Ladder, bucket, rope, squeegee, shovel, amp probe, A-frame, hoist, lifting cable, diffuser hoist, safety harness, safety belt, safety rope Boots, gloves, equipment maintenance manual, paint, pencil and paper Safety glasses, hard hat, rain suit, safety shoes, or boots Filter, snummber, manuometer/air flow meter, main air control valve, aeration rate adjustment valve, diffusers – hand/self cleaned blower, blower motor, return sludge valve, return sludge telescope valve, return sludge pumps, blower motor amp meter, flow weir, aerator, power cable for aerator, mooring cables for aerator, air intake/discharge valve	Perform preventive maintenance per equipment maintenance manual Identify malfunctions indicated Report cause of malfunction verified Obtain directions and parts necessary for repair Disassembles, repairs, reassemble, and check Record repairs on maintenance records	Hand railings Life preservers and hooks Skid proof footing First aid kit Fire extinguisher Oxygen deficiency practices Falling in Noxious fumes Slippery footing Infectious diseases Head and body injury Electrical/fire motor Suspend above water Electrocution by from the power line in the water

DECISIONS	CUES	ERRORS
Decide whether object is to be taken out of operation Determine repair method Ascertain whether repair is adequate after completed Determine whether to clean or replace element Determine whether high/low pressure/air flow; clean diffusers, and clean filter and snubber or check for air leaks in system Determine whether to lubricate it Determine whether to ascertain whether diffusers or lines are plugged Determine whether to (continued - next page)	Operator's reports Equipment Maintenance Manual Maintenance records Acts of Bod Determine proper operation of equipment Determine dirt and dust accumulation Determine dirt and dust accumulation, and noise volume Pressure level (high or low) Hard to turn Bubble roll appearance Excessive heat (Continued on the next page)	Process failure due to insufficient air Overheating and failure of blower unit; process failure due to insufficient air Too much/too little Too much/too little air supply Motor failure (shut off report to supervisor) Blower failure (shut off report to supervisor) Too much/too little sludge Kick out, over-heat, sludge High amperage indicates excessive load on blower, and results in blower failure Low amperage – surging – insufficient air supply, (continued on the next page)

(TASK STATEMENT) MAINTAIN SLUDGE WASTING EQUIPMENT AND AEROBIC DIGESTER (CONTINUED)

DECISIONS	CUES	ERRORS
check blower; check flow meter; check amperage	Oil and temperature levels (low or high)	blower failure, and process failure
Determine whether to find air leak in line, or check for plugged line, or valve too high above water line level	Either hardness of turning and low/high return rate, or free flowing, and hardness of turning	Overheating – failure of unit
Determine whether to clean it, check discharge valve, make sure it is clean and check power supply to pump	Rate of flow, plugged	Too much/too little sludge introduced into system
High amperage – check for line restriction on discharge	Amperage meter (high or low)	Short-circuiting; improper detention, and flow velocity
Low amperage – check for line restriction on inlet or plugged filter	Aerator: oil – low, temperature – high; level water spray patterns	Potential electrocution
Determine whether to add oil, requires maintenance – report unusual spray patterns conditions	Difficulty of turning, low return rate	Mixing will be short circuited
Determine whether to grease; find air leak in line	Difficulty of turning, free flowing	
Determine whether to grease; check for plugged line or valve too high above water level	Rate of flow; plugged	
Determine whether to clean it and check discharge valve	Evenness of flow over weir	
Determine whether to make level	Sagging power cable in water	
Determine whether to suspend power cable above water	Sagging mooring cables are tight	
Determine whether to tighten cables	Frayed or sagging	
Determine whether to tighten cables or replace		

(TASK STATEMENT) MAINTAIN SLUDGE WASTING EQUIPMENT AND AEROBIC DIGESTER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [above tools] Effect of heating and cooling on expansion of materials [motor, blower, pump] Fluids under pressure [gas, oxygen] Forces acting on a body immersed or floating in a liquid [pumps] Transfer of energy from one form to another [pumps] Inertia and momentum [pumps] Effects of friction on work processes and product quality [motor, blower, pumps, valves] Arrangement of molecules, atoms, and ions and the effect on structure and strength of materials [motor, blower, pumps, valves] Resistance of materials to change in shape [motor, blower, pumps, and valves] Behavioral science (see appendix)	Positive rational numbers Use of numbers (without calculation) Counting Measurement: non-geometric Time, temperature, and speed (example: feet per minute, R.P.M., etc.) Read and interpret tables, charts, and graphs – representational graphs Basic logic Deductive or inductive Implications/converse/inverse/contrapositive Arguments/test for validity

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary, logic, and usage
Reading		Comprehension, informational reports, recommendation reports, progress reports
Writing		Memo format, description, reports, terminology/general vocabulary, clarity of expression, and logic
Listening		Noise discrimination (recognize proper and improper sounds; animal, human, machine)
Viewing		Visual analysis (seeing the parts in relation to the whole), logic (ordering of thoughts)
Touching		Temperature
Smelling		Fire, and septic odor

(TASK STATEMENT) MAINTAIN AN ANAEROBIC DIGESTER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics hand tool kit Thirty-six inch pipe wrench Hoist, ladders, packing puller, grease gun, amp-probe, high pressure, water hose, explosion meter Stick grease, grease, oil, mercury, packing, gloves, hard hat, safety shoes, safety goggles, electrical wiring diagram, construction blueprint, repair parts Valves, piping, pumps, motors, electrical control panels manometer, waste gas burner, boiler, heat exchanger, gas regulating valves, flame traps, rollers – floating cover, condensation traps, thermal safety valves, fire eye, thermometer	Determine source of trouble Report cause of difficulty Obtain directions and parts necessary for repair Perform preventive or major maintenance according to manufacturers instructions Record repairs on maintenance records	Safe footing Use of explosion meter Proper lighting Explosion proof lights and control pannels Proper lifting techniques Head and bodily injury Explosion Muscle strains – back injuries Follow all safety rules in lighting gas equipment Infection by contact or ingestion of pathogens

DECISIONS	CUES	ERRORS
Determine whether to repair, replace, or clean Determine if minor or major repairs are needed Determine if motor or electrical systems need repaired or replaced Determine if power is available at control panel outlet Determine whether to clean glass and calibrate Determine whether to check pilot light, and gas availability through regulating valve Determine whether to check fire eye, gas supply, and automatic safety devices (continued on next page)	Valve leaking, frozen, or broken Pipe leaking, or no flow through pipe Leaks, noise, heat, low discharge rate Noise, heat, and complete failure Failure of subsequent equipment Inaccurate readings, or dirty sight glass No flame No heat Loss of heat transfer No flame at waste gas burner, or heat exchanger Normal scheduled maintenance (continued on next page)	Safety hazards, and poor operation Explosion (gas line) inadequate treatment (liquid line) Equipment failure or process failure Unnecessary control panel repairs Damage to equipment Danger of explosion Process failure Low digester temperature, and excess use of fuel Danger of explosion; use of purchased fuel Explosion (continued on next page)

(TASK STATEMENT) MAINTAIN AN ANAEROBIC DIGESTER, CONTINUED

DECISIONS	CUES	ERRORS
Determine whether to clean heat exchanger tubes Determine if gas is burnable Determine if gas supply lines are open Determine whether to repair or replace valve Determine whether to clean or not Determine to free-up or replace Determine if gas to reaching trap – shut down gas using equipment until repaired Determine if thermal plug failed – replace if necessary Determine whether to clean fire eye Determine whether to calibrate and replace	No drainage, or gas leak No gas flow Heat exchanger or boiler fails to light Breakage or separation Gas supply valves do not turn	Cover tipping Explosion and process failure Unable to use sludge gas – purchased fuel Process failure due to low temperature Excess fuel consumption or improper digester temperature

(TASK STATEMENT) MAINTAIN AN ANAEROBIC DIGESTER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools] Effect of heating and cooling on expansion of materials [frozen valves] Magnetic fields of force [electrical motor, instruments] Fluids under pressure [valve and pump operation] Transfer of heat from one body to another [heat exchanger] Resistance of materials to flow of electrical current [wiring shorts] Effects of friction on work processes and product quality [reason for equipment failure] General science knowledge/experience of machinery of a mechanic Behavioral science (see appendix)	Hindu-Arabic numeral system: number/numeral, place value/expanded notation Positive rational numbers Use of numbers (without calculation): counting, coordinate system, coding, and ratio Fundamental operations (calculation): addition, subtraction, multiplication, and division algorithms Basic arithmetic skills and concepts: Reduction of fractions; changing mixed numbers to improper fractions; changing percents to fractions and fractions to percents; finding a percent of a number and what percent one number is of another; changing fractions to decimals and decimals to fractions; ratio and proportion; estimation; rounding off decimals and whole numbers; approximation using scientific notation; guess and check method; rule of thumb Use of computing devices and mechanical aids: calculators – electrical Basic measurement skills and concepts: "Measure sense"/role of "unit" (continued on next page)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary; enunciation; clarity of expression; logic
Reading		Comprehension; detail/inference; informational reports; physical experiment reports; description of mechanism; terminology; process report – instructions
Writing		Penmanship; spelling; reports; terminology/general vocabulary; logic; usage
Listening		Auditory discrimination; discriminate facts from non-facts; recognize opinions; concentration; logic (continued on next page)

(TASK STATEMENT) MAINTAIN AN ANAEROBIC DIGESTER, CONTINUED

SCIENCE	MATH – NUMBER SYSTEMS
	instruments: given an instrument of measure, determine precision and/or accuracy with respect to relative error, significant digits, and tolerance; Metric and English measure and conversion; rate; measurement: geometric – linear, area, volume, and angle; measurement: non-geometric – time money, temperature, weight, liquid, dry, speed, pressure; conversion from one standard unit to another; read and interpret tables, charts, and graphs: logs Basic algebra skills and concepts: use of variables– in formulae, and in equations; manipulation of formulae Basic logic: Deductive or inductive; implications/converse/inverse/contrapositive

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
		(ordering of thoughts and ideas); noise discrimination (recognize proper and improper sounds; animal, human, and machine)
Viewing		Visual analysis (seeing the parts in relation to the whole); memory (short and long term retention); describing (discrimination and verbalization of physical characteristics); logic (ordering of thoughts and perceptions); detail and inference; color discrimination; recognition of symbols, codes, and emblems
Touching Smelling		All tactile sensations inherent in machine repair Gas detection

Duty I Performing Biological Decomposition Via Activated Sludge Processes (Contact Stabilization, Step Aeration, Conventional Activated Sludge, and Extended Aeration)

1. Maintain activated sludge processes (to include: contact stabilization, step aeration, conventional activated sludge, and extended aeration)

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(TASK STATEMENT) MAINTAIN ACTIVATED SLUDGE PROCESSES (TO INCLUDE: CONTACT STABILIZATION, STEP AERATION, CONVENTIONAL ACTIVATED SLUDGE, AND EXTENDED AERATION) 45

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance mechanics tool kit Gear puller Thirty-six inch pipe wrench Three-foot level Paint brushes Ladder, bucket, rope, squeegee, shovel, amp probe, A-frame, hoist, lifting cable, diffuser hoist, safety harness, safety belt, safety rope Boots, gloves, equipment maintenance manual, paint, pencil and paper Safety glasses, hard hat, rain suit, safety shoes, boots Filter, snubber, manometer/air flow meter, main air control valve, aeration rate adjustment valve, diffusers–hand/self cleaned, blower, blower motor, return sludge valve, return sludge telescope valve, return sludge pumps, blower motor amp meter, flow weir, aerator, power cable for aerator, mooring cables for aerator, air intake/discharge valve	Perform preventive maintenance per equipment maintenance manual Identify malfunctions indicated Report cause of malfunction verified Obtain directions and parts necessary for repair Disassembles, repairs, reassemble, and check Record repairs on maintenance records Diffused aerators only: Check for clogged air diffusers when excessive air heater temperatures or excessive air back pressure is indicated Mechanical aerators only: Determine if oil viscosity in mechanical aerators is matched to average ambient air temperature; change oil to correspond with seasonal average temperature	Hand railings Life preservers and hooks Skid proof footing First aid kit Fire extinguisher Oxygen deficiency practices Falling in Noxious fumes Slippery footing Infectious diseases Head and body injury Electrical/fire motor Suspend above water Electrocution from the power line in the water

DECISIONS	CUES	ERRORS
Decide whether the object is to be taken out of operation Determine repair method Ascertain whether repair is adequate after completed Determine whether to clean or replace element Determine whether high/low pressure/air flow; clean diffusers, and clean filter and snubber or check for air leaks in system Determine whether to lubricate it Determine whether to ascertain whether diffusers or lines are plugged Determine whether to (continued–next page)	Operator's reports Equipment Maintenance Manual Maintenance records Acts of God Determine proper operation of equipment Determine dirt and dust accumulation Determine dirt and dust accumulation, and noise volume Pressure level (high or low) Hard to turn Bubble roll appearance Excessive heat (continued on the next page)	Process failure due to insufficient air Over-heating and failure of blower unit; process failure due to insufficient air Too much/too little Too much/too little air supply Motor failure (shut off report to supervisor) Blower failure (shut off report to supervisor) Too much/too little sludge Kick out, over-heat, sludge High amperage indicated excessive load on blower, and results in blower failure Low amperage – surging – insufficient air supply, (continued on the next page)

(TASK STATEMENT) MAINTAIN ACTIVATED SLUDGE PROCESSES (TO INCLUDE: CONTACT STABILIZATION, STEP AERATION, CONVENTIONAL ACTIVATED SLUDGE, AND EXTENDED AERATION)

DECISIONS	CUES	ERRORS
check blower; check flow meter; check amperage Determine whether to find air leak in line, or check for plugged line, or valve too high above water line level Determine whether to clean it, check discharge valve, make sure it is clean and check power supply to pump High amperage – check for line restriction on discharge Low amperage – check for line restriction on inlet or plugged filter Determine whether to add oil, requires maintenance – report unusual spray patterns conditions Determine whether to grease; find air leak in line Determine whether to grease; check for plugged line or valve too high above water line level Determine whether to clean it and check discharge valve Determine whether to make level Determine whether to suspend power cable above water Determine whether to tighten cables Determine whether to tighten cables or to replace them	Oil and temperature levels (low or high) Either hardness of turning and low/high return rate, or free flowing, and hardness of turning Rate of flow, plugged Amperage meter (high or low) Aerator: oil – low, temperature – high, level water spray patterns Difficulty of turning, low return rate Difficulty of turning, free flowing Rate of flow; plugged Evenness of flow over weir Sagging power cable in water Sagging mooring cables are tight Frayed or sagging Difference in average daily temperature in summer and winter seasons	blower failure, and process failure Over-heating – failure of unit Too much/too little sludge introduced into the system Short-circuiting; improper detention, and flow velocity Potential electrocution Mixing will be short circuited

(TASK STATEMENT) MAINTAIN ACTIVATED SLUDGE PROCESSES (TO INCLUDE: CONTACT STABILIZATION, STEP AERATION, CONVENTIONAL ACTIVATED SLUDGE, AND EXTENDED AERATION

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools] Effect of heating and cooling on expansion of materials [motor, blower, pumps] Fluids under pressure [gas, oxygen] Forces acting on a body immersed or floating in a liquid [pumps] Transfer of energy from one form to another [pumps] Inertia and momentum [pumps] Effects of friction on work processes and product quality [motor, blower, pumps, valves] Arrangement of molecules, atoms, and ions, and the effect on structure and strength of materials [motor, blower, pumps, valves] Resistance of materials to change in shape [motor, blower, pumps, and valves] Behavioral science (see appendix)	Positive rational numbers Use of numbers (without calculation) Counting Measurement: non-geometric Time, temperature, and speed (example: feet per minute, R.P.M., etc.) Read and interpret tables, charts, and graphs – representational graphs Basic logic Deductive or inductive Inplications/converse/inverse/contrapositive Arguments/test for validity

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Writing Listening Viewing Touching Smelling		Terminology/general vocabulary, logic, and usage Comprehension, informational reports, recommendation reports, progress reports Memo format, description, reports, terminology/general vocabulary, clarity of expression, and logic Noise discrimination (recognize proper and improper sounds; animal, human, machine) Visual analysis (seeing the parts in relation to the whole), logic (ordering of thoughts) Temperature Fire, and septic odor

Duty J Performing Biological Decomposition Via Trickling Filters

1. Maintain high and low rate trickling filters

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(TASK STATEMENT) MAINTAIN HIGH AND LOW RATE TRICKLING FILTERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Standard maintenance tool kit High pressure hose Fire hose wrench Large pipe wrenches – thirty-six inches Paint brushes Pipe threader – four-inch capacity Pipe cutter Valve wrench Four-foot level Fork, shovel, and boots Gaskets, packing, replacement media, pipe, paint, turnbuckles, oil, mechancial seal, and grease Crane Trickling filters Recirculation pumps Dosing tank Valves Lines	Flushing distributor lines and dosing chamber lines and laterals Repair or replace nozzles Flush ponding areas with high pressure hose Replace broken media Overhaul distributor, seals, and bearings Repair valves Repair recirculating pumps Level distributor arms Test equipment for proper operation Enter repairs on maintenance record cards	Handling mercury from comminutor seal – avoid contact from fumes or liquid mercury Infection by contact with or ingestion of pathogens Asphyxiation by toxic gases Suffocation from oxygen deficiency Explosion or fire from flammable solvents Keep ventilation fans on Pinched against moving machinery – guards Slipping on slippery surfaces – housekeeping, rubber mats, skid-proofing surfaces Back strain through improper lifting techniques – proper lifting techniques Electrical shock from improperly grounded electrical equipment – ground rubber mats Electrical shock – lock out equipment before working on it
DECISIONS Determine how, where, when, and how long to flush distributor lines Determine if defect is economically repairable Determine how long, how much ponding area to flush Determine how much to replace Determine whether to repair or replace parts and mercury seal Determine whether to repack or rebuild Determine what turnbuckles to adjust Determine what is proper operation for this equipment Determine what to enter on repair record cards	**CUES** Operator's report and signs of plugging Uneven spray pattern Ponding Visual inspection Leakage, erratic rotation Leaks, hard operating, broken Erratic, uneven rotation Repairs	**ERRORS** Not enough time, too low a pressure, too high a pressure Strip threads Improper hosing, loo low a pressure Too much, or not enough Failing to replace all worn parts – assemble wrong Not level, erratic shortened life operation Improper evaluation of future repairs No spare parts on hand for next repair

(TASK STATEMENT) MAINTAIN HIGH AND LOW RATE TRICKLING FILTERS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [simple tools] Fluids under pressure [hydrostatic pressure] Centrifugal forces developed by bodies in rotation [rotating distributor] Inertia and momentum [rotating distributor has momentum] Resistance of materials to change in shape [seals, guy wires] Behavioral science (see appendix)	Positive rational numbers Fundamental operations (calculation): addition, subtraction, multiplication, and division algorithms, and order of operations Basic arithmetic skills and concepts ratio and proportion – estimation: recirculation ratio, dosing cycles Basic measurement skills and concepts: "measure sense"/role of "unit" ; instruments: ruler, micrometer, calipers–measure wear; rate: flow measurement; measurement: geometric – volume; measurement: non-geometric – speed (r.p.m., distributor) Basic geometry skills and concepts: knowledge of geometric relationships – parallel, perpendicular, and skew (distributor)

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking		Terminology/general vocabulary
Reading		Comprehension, and process report – instructions
Writing		Memo format
Listening		Auditory discrimination, and noise discrimination (recognize proper and improper sounds; animal, human, and machine)
Viewing		Visual analysis (seeing the parts in relation to the whole), describing (discrimination and verbalization of physical characteristics), and color discrimination
Touching		Texture, motion-vibration, and pressure
Smelling		Odor

Duty K Performing Biological Decomposition Via Oxidation Lagoons/Ponds (Faculative, Aerobic, and Anaerobic)

1. Maintain oxidation ponds/lagoons for secondary treatment (to include: aerated (facultative), strictly aerobic and anaerobic ponds/lagoons)

(TASK STATEMENT) MAINTAIN OXIDATION PONDS/LAGOONS FOR SECONDARY TREATMENT (TO INCLUDE: AERATED (FACULTATIVE), AND STRICTLY AEROBIC AND ANAEROBIC PONDS/LAGOONS)

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TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Rake, shovel, measuring stick, boat, life preserver, hand skimming device, bucket, boots, pencil and paper Influent and effluent locations, waste water, scum and debris, levee material, and sludge deposits Standard maintenance mechanics tool kit, gear puller, thirty-six inch pipe wrench, three-foot level, paint brushes, ladder, bucket, rope, squeegee, shovel, amp prove, A-frame, hoist, lifting cable, diffuser, hoist, safety harness, safety belt, safety rope, safety glasses, hard hat, rain suit, safety shoes, and boots Filter, snubber, manometer/air flow meter, main air control valve, aeration rate adjustment valve, diffusers—hand/self cleaned, blower, blower motor and ampmeter air intake/discharge valve, aerator, flow weir, power cable for aerator, mooring cable aerator	Perform preventive maintenance per equipment maintenance manual Identify malfunctions indicated Report cause of malfunction verified Obtain directions and parts necessary for repair Disassembles, repairs, reassemble, and check Record repairs on maintenance records Clean up floating scum, debris and sludge Repair and maintain levee banks Determine sludge deposit locations, and remove Cut weeds	Hand railings Life preservers and hooks Skid proof footing First aid kit Fire extinguisher Oxygen deficiency practices Falling in Noxious fumes Slippery footing Infectious diseases Head and body injury Electrical/fire motor Suspend above water Electrocution from the power line in the water Safe boating practices Boating hazards (drowning, etc.)
DECISIONS	**CUES**	**ERRORS**
Determine whether to clean, repair, remove, and cut when specific problem exists Decide whether the object is to be taken out of operation Determine repair method Ascertain whether repair is adequate after completed Determine whether to clean or replace element Determine whether high/low pressure/air flow; clean diffusers, and clean filter and snubber or check for air leaks in system Determine whether to lubricate it (continued on the next page)	Visual observation Operator's reports Equipment Maintenance Manual Maintenance records Acts of God Determine proper operation of equipment Determine dirt and dust accumulation, and noise volume Pressure level (high or low) Hard to turn Bubble roll appearance Excessive heat (continued on the next page)	Process failure due to insufficient air Over-heating and failure of blower unit; process failure due to insufficient air Too much/too little – air supply Motor failure (shut off, report to supervisor) Blower failure (shut off, report to supervisor) Too much/too little sludge Kick out, over-heat, too much/too little sludge Decreased treatment and deterioration of physical plant

(TASK STATEMENT) MAINTAIN OXIDATION PONDS/LAGOONS FOR SECONDARY TREATMENT (TO INCLUDE: AERATED (FACULTATIVE), AND STRICTLY AEROBIC AND ANAEROBIC PONDS/LAGOONS)

DECISIONS	CUES	ERRORS
Determine whether to ascertain whether diffusers or lines are plugged Determine whether to check flow meter; check blower; check amperage Determine whether to find air leak in line, or check for plugged line, or valve too high above water line level Determine whether to clean it, check discharge valve, make sure it is clean and check power supply to pump High amperage – check for line restriction on discharge Low amperage – check for line restriction on inlet or plugged filter Determine whether to add oil, requires maintenance – report unusual spray patterns conditions Determine whether to grease; find air leak in line Determine whether to clean it and check discharge valve Determine whether to make level Determine whether to suspend power cable above water Determine whether to tighten cables Determine whether to tighten cables or to replace them	Oil and temperature levels (low or high) Either hardness of turning and low/high return rate, or free flowing, and hardness of turning Rate of flow, plugged Amperage meter (high or low) Aerator: oil – low, temperature – high, level water spray patterns Difficulty of turning, low return rate Difficulty of turning, free flowing Rate of flow; plugged Evenness of flow over weir Sagging power cable in the water Sagging mooring cables are tight Frayed or sagging	

(TASK STATEMENT) MAINTAIN OXIDATION PONDS/LAGOONS FOR SECONDARY TREATMENT (TO INCLUDE: AERATED (FACULTATIVE), AND STRICTLY AEROBIC, AND ANAEROBIC PONDS/LAGOONS)

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools] Effect of heating and cooling on expansion of materials [motor, blower, pumps] Fluids under pressure [gas, oxygen] Forces acting on a body immersed or floating in a liquid [pumps] Transfer of energy from one form to another [pumps] Inertia and momentum [pumps] Effects of friction on work processes and product quality [motor, blower, pumps, valves] Arrangement of molecules, atoms, and ions, and the effect on structure and strength of materials [motor, blower, pumps, and valves] Resistance of materials to change in shape [motor, blower, pumps, and valves] Behavioral science (see appendix)	Positive rational numbers Use of numbers (without calculation) Counting Measurement: non-geometric Time, temperature, and speed (example: feet per minute, R.P.M., etc.) Read and interpret tables, charts, and graphs – representational graphs Basic logic Deductive or inductive Implications/converse/inverse/contrapositive Arguments/test for validity

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Writing Listening Viewing Touching Smelling		Terminology/general vocabulary, logic, and usage Comprehension, informational reports, recommendation reports, progress reports Memo format, description, reports, terminology/general vocabulary, clarity of expression, and logic Noise discrimination (recognize proper and improper sounds; animal, human, and machine) Visual analysis (seeing the parts in relation to the whole), logic (ordering of thoughts) Temperature Fire, and septic odor

Duty L Performing Chlorination

1. Maintain pre and post treatment chlorinating systems (to include: liquid and gas treatment)

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(TASK STATEMENT) MAINTAIN PRE AND POST TREATMENT CHLORINATING SYSTEMS (TO INCLUDE: LIQUID AND GAS TREATMENT)

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Maintenance standard tool kit Valve and nut Wrench Amperage probe Equipment maintenance manual, pencil and paper, lead washers, whips, teflon tape Y-strainer, pumps, rotameter, chlorine container, scales, cradles, hoist and lifting clamp, connector tubing (whips), chlorine recorder, valves (shut-off, relief, check, safety, gas, liquid), pressure gages, feeders (vacuum, partial vacuum, pressure, and pulsating), exhaust fans, safety equipment, control equipment, evaporator (for liquid ammonia withdrawl), mixing chamber (for hypochlorinate solution), diffusers, contact chamber, thermometer Hard hats, ammonia tester, safety shoes, air pack, color comparator, water sampler, and gas mask	Perform preventive maintenance per equipment maintenance manual Identify malfunctions indicated Report cause of malfunction verified Obtain directions and parts necessary for repair Disassembles, repairs, reassemble, and check Record repairs on maintenance records	Air pack, gas cannister, exhaust fans – oxygen deficiency practices Hard hat, and safety shoes Fire extinguisher First aid kit Proper team rescue operations and notification procedures Training in proper ammonia handling procedures Ammonia container repair procedures Noxious fumes Head and body injury Electrical/fire motor Ammonia burns Contamination of clothes with ammonia

DECISIONS	CUES	ERRORS
Decide whether object is to be taken out of operation Determine repair method Ascertain whether repair is adequate after completed Determine whether to send back if overweight; call safety alert Determine whether to report if not operational Determine whether to take out of operation and have repaired Determine whether to replace with new tube, and lead washer; and report; see if chlorine flow is too great (continued on next page)	Operator's reports Equipment maintenance manual Maintenance records Check for overweight, leaks Operational Cracks, splinters Creaking, working hard Discoloration (turns green), iced Abnormal readings; too high/too low Malfunctions – leakage On the floor, exits outside, switches on outside of the chlorine room; blades face proper direction (continued on the next page)	Insufficient disinfection Major safety hazard which may result in death of the operator

(TASK STATEMENT) MAINTAIN PRE AND POST TREATMENT CHLORINATING SYSTEMS (TO INCLUDE: LIQUID AND GAS TREATMENT), CONTINUED

DECISIONS	CUES	ERRORS
Determine whether recorder or system is malfunctioning	Cannisters not out of date; rubber mask fits, and is not cracked; air pack is full	
Determine if gage or system is malfunctioning	Malfunctions – leakage, hard to turn, plugged lines, signs of corrosion	
Determine if feeder or system is malfunctioning	Leakage, malfunction in stirring mechanism	
Determine if it is operating adequately	Plugged	
Determine whether to unplug	Bubbles, sludge deposition, short-circuiting	
Determine whether to clean out	Below fifty degrees, Fahrenheit, in the room	
Determine whether to shut it off if temperature is too low, and repair	Low ammonia pressure and lines and cylinders cold or icing	
Determine if cylinder capacity is sufficient, and cylinder temperature is less than control equipment temperature	No ammonia pressure with full cylinders	
Determine if a flow restriction exists in the ammonia header system on the feeder, or at the external chlorine pressure reducing valve	Rotameter iced over, and feed rate erratic and lines iced, cylinders	
Determine if cylinder has broken dip tube	Chlorinator will not feed; pressure is normal and control valve is open	
Determine if obstruction exists in ammonia line prior to CPRV at inlet cartridge; or temperature of cylinders hotter than control equipment	Ammonia is leaking from vent line to external chlorine pressure reducing valve (CPRV)	
Determine leak location and cause with respect to CPRV	Icing line between CPRV and chlorinator	
Determine if inlet cartridge to CPRV is blocked or the evaporator needs to be cleaned	Water – bath temperature in evaporator – chlorinator is too low to keep CPRV open	
Determine if water bath heating elements need to be replaced	Low feed rate, but adequate pressure	
Determine if injector vacuum is sufficient	Cannot maintain adequate feed rate	
Determine if water pressure has changed	Chlorine odor at point of application	
Determine if feed rate is too high or if there is a broken line	Insufficient ammonia residual periodically during the day	
Determine if feed rates are being varied with the flow and concentration of waste water	Ammonia recorder does not appear to control residual properly	
Determine if residual and contact time are sufficient	Coliform bacteria count is too high	
	Cracked packing, hardness of turning, leakages	

(TASK STATEMENT) MAINTAIN PRE AND POST TREATMENT CHLORINATING SYSTEMS (TO INCLUDE: LIQUID AND GAS TREATMENT)

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [tools] Effect of heating and cooling on expansion of materials [motor, blower, pumps] Fluids under pressure [gas, oxygen] Forces acting on a body immersed or floating in a liquid [pumps] Transfer of energy from one form to another [pumps] Inertia and momentum [pumps] Effects of friction on work processes and product quality [motor, blower, pumps, valves] Arrangement of molecules, atoms, and ions, and the effect on structure and strength of materials [motor, blower, pumps, valves] Resistance of materials to change in shape [motor, blower, pumps, and valves] Behavioral science (see appendix)	Positive rational numbers Use of numbers (without calculation) Counting Measurement: non-geometric Time, temperature, and speed (example: feet per minute, R.P.M., etc.) Read and interpret tables, charts, and graphs – representational graphs Basic logic Inductive or deductive Implications/converse/inverse/contrapositive Arguments/test for validity

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COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking Reading Writing Viewing Touching Smelling Listening		Terminology/general vocabulary, logic, and usage Comprehension, informational reports, recommendation reports, progress reports Memo format, description, reports, terminology/general vocabulary, clarity of expression, and logic Visual analysis (seeing the parts in relation to the whole), logic (ordering of thoughts) Temperature Fire and septic odor Noise discrimination

APPENDIX
BEHAVIORAL SCIENCE

Professionalism

A. Maintain capacity to foster trust
B. Maintain capacity to foster confidentiality
C. Maintain capacity to foster cooperation
D. Maintain capacity to generate integrity
E. Maintain capacity to cope with conflict behavior
F. Maintain capacity to function efficiently when encountering fast changing, multiple, personal or situational varibles
G. Exhibit qualities of self-confidence, self-control, self-reliance, self-respect, and adaptability

Supervision

A. Distribute personnel with regard to leadership qualities and experiences for optimum team performance
B. Maintain customer's illusion of privacy by avoiding excessive noise or movement
C. Grant appropriate regard for customer's personal space (convenience and special interest)
D. Grant conscious attention to smoothly flowing team work
E. Maintain regard for differing views on maximum efficiency of the operations
F. Grant appropriate regard for customer's unique needs
G. Exhibit capacity to ascertain best service for the particular party type requested
H. Show and describe facilities with appropriate speed and clarity
I. Communicate pride in establishment

Attributes of Maximum Functioning Capacity

Conscious awareness of the need for a balance (both physical and mental) between tension and relaxation. Relates to:

1. Comfort
2. Caution
3. Safety
4. Physical, emotional, and intellectual health

Conscious awareness of physical expressions basic to peak physical performance:

1. Body rhythm
2. Breathing coordinated with body movement
3. Body balance and posture
4. Movement from tension to relaxation and vice versa

Conscious awareness of qualities basic to optimal mental performance:

1. Attention
2. Observation
3. Concentration
4. Mental alertness
5. Mental quietude
6. Mental clarity
7. Organization

TOOL KITS

Standard Maintenance Mechanics Hand Tool Kit

- Needle nose pliers
- Side cutting pliers
- Water pump pliers
- Wrench sets: Box end, Open end, Socket and Allen
- Assorted electrical screwdrivers (Conventional and Phillips)
- Putty knife
- 6' folding rule
- 6", 8", and 12" crescent wrench
- Pipe cutter and threader
- Vise grips
- 24" pipe wrench
- 14" pipe wrench
- 8" pipe wrench
- Hack saw
- Pry bar
- Assorted files
- Feelers gauge
- 12' steel rule
- 2 lb. machinist hammer
- 6 lb. small sledge
- Wire brush
- Electrical tape
- Teflon tape
- Pocket knife

TOOL KITS

Standard Operators Tool Kit (SOTK)

- 6", 8", and 12" crescent wrench
- One set Allen wrenches
- Vise grip pliers
- Assorted electrical screwdrivers
- Machinist hammer
- 12' steel tape
- Pipe wrench

GLOSSARY OF TERMS USED IN WASTEWATER TREATMENT

Acid – (1) A substance that tends to lose a proton. (2) A substance that dissolves in water with the formation of hydrogen ions. (3) A substance containing hydrogen which may be replaced by metals to form salts.

Activated Carbon – Carbon particles usually obtained by carbonization of cellulosic material in the absence of air and possessing a high adsorptive capacity.

Activated Sludge – Sludge floc produced in raw or settled wastewater by the growth of zoogleal bacteria and other organisms in the presence of dissolved oxygen and accumulated in sufficient concentration by returning floc previously formed.

Activated Sludge Loading – The pounds of biochemical oxygen demand (BOD) in the applied liquid per unit volume of aeration capacity or per pound of activated sludge per day.

Activated Sludge Process – A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) be sedimentation and wasted or returned to the process as needed.

Activation – (1) The generation, under aerobic conditions, of organisms capable of absorbing organic material from the water in the activated sludge process.

Aerated Pond – A natural or artificial wastewater treatment pond in which mechanical or diffused-air aeration is used to supplement the oxygen supplement the oxygen supply.

Aeration – (1) The bringing about of intimate contact between air and a liquid by one or more of the following methods: (a) spraying the liquid in the air, (b) bubbling air through the liquid, (c) agitating the liquid to promote surface absorption of air. (2) The supplying of air to confined spaces under nappes, downstream from gates in

conduits, etc., to relieve low pressures and to replenish air entrained and removed from such confined spaces by flowing water. (3) Relief of the effects of cavitation by admitting air to the section affected.

Aeration Period – (1) The theoretical time, usually expressed in hours, during which mixed liquor is subjected to aeration in an aeration tank while undergoing activated sludge treatment. It is equal to the volume of the tank divided by the volumetric rate of flow the the wastewater and return sludge. (2) The theoretical time during which water is subjected to aeration.

Aeration Tank – A tank in which sludge, wastewater, or other liquid is aerated.

Aerobic – Requiring, or not destroyed by, the presence of free elemental oxygen.

Aerobic Bacteria – Bacteria that require free elemental oxygen for their growth.

Aerobic Digestion – Digestion of suspended organic matter by means of aeration. See Digestion.

Agglomeration – The coalescence of dispersed suspended matter into larger flocs or particles which settle rapidly.

Agitator – Mechanical apparatus for mixing and/or aerating; a device for creating turbulence.

Air-Lift – A device for raising liquid by injecting air in and near the bottom of a riser pipe submerged in the liquid to be raised.

Air Relief Valve – An air valve placed at the summit of a pipeline to release the air automatically and prevent the pipeline from becoming air-bound with a resultant increase of pressure.

Algae – Primitive plants, one- or many-celled, usually aquatic, and capable of elaborating their foodstuffs by photosynthesis.

Algal Bloom – Large masses of microscopic and macroscopic plant life, such as green algae occurring in bodies of water. See Bloom.

Alum – A common name in the water and wastewater treatment field, for commercial-grade aluminum sulfate.

Amp Meter – An electrical measuring device which shows the flow of current through an electrical circuit.

Anaerobic – Requiring, or not destroyed by, the absence of air or free (elemental) oxygen.

Anaerobic Bacteria – Bacteria that grow only in the absence of free elemental oxygen.

Anaerobic Digestion – The degradation of organic matter brought about through the action of microorganisms in the absence of elemental oxygen.

Appurtences – Machinery, appliances, or auxiliary structures attached to a main structure to enable it to function, but not considered an integral part of it.

Assimilative capacity – The capacity of a natural body of water to receive: (a) wastewaters, without deleterious effects; (b) toxic materials, without damage to aquatic life or humans who consume the water; (c) BOD, within prescribed dissolved oxygen limits.

Available Chlorine – A measure of the total oxidizing power of chlorinated lime and hypochlorites.

Available oxygen – The quantity of dissolved oxygen available for oxidation of organic matter in a water body.

Axial-Flow Pump – A type of centrifugal pump which develops most of its head by the propelling or lifting action of the vanes on the liquids. Also called propeller pump.

Back Wash – The reversal of flow through a rapid sand filter to wash clogging material out of the filtering medium and reduce conditions causing loss of head. Also called filter wash.

Bacteria – A group of universally distributed, rigid, essentially unicellular microscopic organisms lacking chlorophyll. Bacteria usually appear as speroid, rod-like, or curved entities, but occasionally appear as sheets, chains, or branched filaments. Bacteria are usually regarded as plants.

Baffles – Deflector vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water, wastewater, or slurry systems to check or effect a more uniform distribution of velocities; absorb energy; divert guide, or agitate the liquids; and check eddies.

Ball Valve – A simple non-return valve consisting of a ball resting on a cylindrical seat within a fluid passageway.

Bar Rack – A screen composed of parallel bars, either vertical or inclined, placed in a waterway to catch debris. The screenings may be raked from it. Also called rack.

Biochemical Process – The process by which the life activities of bacteria and other microorganisms, in search for food, break down complex organic materials into simple, more stable substances. See Oxidation Process.

Biological Filter – A bed of sand, gravel, broken stone, or other medium through which wastewater flows or trickles that depends on biological action for its effectiveness.

Biological Oxidation – The process whereby living organisms in the presence of oxygen, convert the organic matter contained in wastewater into a more stable or a mineral form.

Biological Wastewater Treatment – Forms of wastewater treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Intermittent sand filters, contact beds, trickling filters, and activated sludge processes are examples.

Biota – Animal and plant life, or fauna and flora, of a stream or other water body.

BOD – (1) Abbreviation for biochemical oxygen demand. The quantity of oxygen used in the biochemical axidation of organic matter in a specified time, at a specified temperature, and under specified conditions. (2) A standard test used in assessing wastewater strength.

BOD Load – The BOD content, usually expressed in pounds per unit of time, of wastewater passing into a waste treatment system or to a body of water.

Breakpoint Chlorination – Addition of chlorine to water or wastewater until the chlorine demand has been satisfied and further additions result in a residual that is directly proportional to the amount added beyond the breakpoint.

Buffer – Any of certain combinations of chemicals used to stabilize the pH values or alkalinities of solutions.

Bulking Sludge – An activated sludge that settles poorly because of a floc of low density.

Butterfly Valve – A valve wherein the disk, as it opens or closes, rotates about a spindle supported by the frame of the valve. The valve is opened at a stem. At full opening, the disk is in a position parallel to the axis of the conduit.

Bypass – An arrangement of pipes, conduits, gates, and valves whereby the flow may be passed around a hydraulic structure or appurtenance.

Calibration – (1) The determination, checking, or rectifying of the graduation of any instrument giving quantitative measurements. (2) The process of taking measurements or of making observations to establish the relationship between two quantities.

Capolletti Weir – A flow measuring weir designed to handle both high and low flows accurately.

Cavitation – (1) The action resulting from forcing a flowing stream to change direction in which reduced internal pressure causes dissolved gases to expand, creating negative pressure. Cavitation frequently causes pitting of the hydraulic structure affected. (2) The formation of a cavity between the downstream surface of a moving body, for example, the blade of a propeller, and a liquid normally in contact with it.

Centigrade – A thermometer temperature scale in which 0 degrees marks the freezing point, and 100 degrees the boiling point of water at 760 mm of mercury barometric pressure. Also called Celsius scale. To convert temperature on this scale to Fahrenheit, multiply by 9/5 and add 32.

Centrifugal Pump – A pump consisting of an impeller fixed on a rotating shaft and enclosed in a casing, and having an inlet and a discharge connection. The rotating impeller creates pressure in the liquid by the velocity derived from centrifugal force.

Check Valve – A valve provided with a disk hinged on one edge so that it opens in the direction of normal flow and closes with reversal of flow. An approved check valve is of substantial construction and suitable materials, is positive in closing, and permits no leakage in a direction opposite to the normal flow.

Chemical Coagulation – The destabilization and initial aggregation of colloidal and finely divided suspended matter by the addition of a floc-forming chemical. Also see Flocculation.

Chemical Dose – The application of a specific quantity of chemical to a specific quantity of fluid for a specific purpose. Also see Dose.

Chemical Feeder – A device for dispensing a chemical at a predetermined rate for the treatment of water or wastewater. Change in rate of feed may be affected manually or automatically by flow-rate changes. Feeders are designed for solids, liquids, or gases.

Chemical Oxygen Demand (COD) – A measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater. It is expressed as the amount of oxygen consumed from a chemical oxidant in a specific test. It does not differentiate between stable and unstable organic matter and thus does not necessarity correlate with biochemical oxygen demand. Also known as OC and DOC, oxygen consumed and dichromate oxygen consumed, respectively.

Chemical Precipitation – (1) Precipitation induced by addition of chemicals. (2) The process of softening water by the addition of lime or lime and soda ash as the precipitants.

Chemical Sludge – Sludge obtained by treatment of wastewater with chemicals.

Chemical Treatment – Any process involving the addition of chemicals to obtain a desired result.

Chlorination – The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results.

Chlorine Contact Chamber – A detention basin provided primarily to secure the diffusion of chlorine through the liquid. Also called chlorination chamber.

Chlorine Demand – The difference between the amount of chlorine added to water or wastewater and the amount of residual chlorine remaining at the end of a specified contact period. The demand for any given water varies with the amount of chlorine applied, time of contact, and temperature. See Free Available Chlorine, Free Available Residual Chlorine.

Clarified Wastewater – Wastewater from which most of the settleable solids have been removed by sedimentation. Also called settled wastewater.

Coagulant – A compound responsible for coagulation: a floc-forming agent.

Coagulant Aid – Any chemical or substance used to assist or modify coagulation.

Coagulation – In water and wastewater treatment, the destabilization and initial aggregation of colloidal and finely divided suspended matter by the addition of a floc-forming chemical or by biological processes.

Coarse Rack – A rack with wide spaces between bars, usually of one inch or more.

Colloidal Matter – Finely divided solids which will not settle but may be removed by coagulation or biochemical action or membrane filtration. See Colloids.

Complete Treatment – In an imprecise and general sense, the processing of domestic and some industrial wastewaters by means of primary and secondary treatment. It may include other specialized types of treatment and disinfection. A high percentage removal of suspended, colloidal, and dissolved organic matter is implied.

Composite Wastewater Sample – A combination of individual samples of water or wastewater taken at selected intervals, generally hourly for some specified period, to minimize the effect of the variability of the individual sample. Individual samples may have equal volume or may be roughly proportioned to the flow at time of sampling.

Cone Valve – A valve in which the moving plug is conical; the valve is opened by unscrewing the plug from the seat and turning it through an angle of ninety degrees. Also called conical plug valve.

Contact Stabilization Process – A modification of the activated sludge process in which raw wastewater is aerated with a high concentration of activated sludge for a short period, usually less than sixty minutes, to obtain BOD removal by absorption. The solids are subsequently removed by sedimentation and transferred to a stabilization tank where aeration is continued further to oxidize and condition them before their reintroduction to the raw wastewater flow.

Cross Connection – (1) A physical connection through which a supply of potable water could be contaminated or polluted. (2) A connection between a supervised potable water supply and an unsupervised supply of unknown potability.

Cubic Foot Per Second (cfs) – A unit of measure of the rate of liquid flow past a given point equal to one cubic foot in one second. Previously also called second–foot.

Decomposition of Wastewater – (1) The breakdown of organic matter in wastewater by bacterial action either aerobic or anaerobic. (2) Transformation of organic or inorganic materials contained in wastewater through the action of chemical or biological processes.

Degradation – (1) The breakdown of substances by biological action.

Degree of Treatment – A measure of the removal effected by treatment processes with reference to solids, organic matter, BOD, bacteria, or any other specified matter.

Deposition – The act or process of settling solid material from fluid suspension.

Detention Time – The theoretical time required to displace the contents of a tank or unit at a given rate of discharge (volume divided by rate of discharge).

Diffused– Air aeration – Aeration produced in a liquid by air passed through a diffuser.

Diffuser – A mechanical device designed to convert an air stream into a continuous stream of air bubbles in a decreasing size range.

Digested Sludge – Sludge digested under either aerobic or anaerobic conditions until the volatile content has been reduced to the point at which the solids are relatively nonputrescible and inoffensive.

Disinfection – The art of killing the larger portion of microorganisms in or on a substance with the probability that all pathogenic bacteria are killed by the agent used.

Dispersion – (1) Scattering and mixing. (2) The mixing of polluted fluids with a large volume of water in a stream or other body of water.

Dissolved Oxygen – The oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation. Abbreviated DO .

Dissolved-Oxygen Sag Curve – A curve that represents the profile of dissolved oxygen content along the course of a stream resulting from deoxygenation associated with biochemical oxidation of organic matter and reoxygenation through the absorption of atmospheric oxygen and biological photosynthesis. Also called oxygen-sag curve.

Dissolved Solids – Theoretically, the anhydrous residues of the dissolved constituents in water. Actually, the term is defined by the method used in determination. In water and wastewater treatment, the Standard Methods tests are used.

Ditch Oxidation – A modification of the activated sludge process or the aerated pond, in which the mixture under treatment is circulated in an endless ditch and aeration and circulation are produced by a mechanical device such as a Kessener brush.

Domestic Wastewater – Wastewater derived principally from dwellings, business buildings, institutions, and the like. It may or may not contain ground water, surface water, or storm water.

Dose – (1) The quantity of substance applied to a unit quantity of liquid for treatment purposes. It can be expressed in terms of either volume or weight, e.g., pounds per million gallons, parts per million, grains per gallon, milligrams per liter, or grams per cubic meter.

Dosing tank – Any tank used in applying a dose. Specifically used for intermittent application of wastewater to subsequent processes.

Dry Feeder – A feeder for dispensing a chemical or other fine material in the solid state to water or wastewater at a rate controlled manually or automatically by the rate of flow. The constant rate may be either volumetric or gravimetric.

Duplex Pump – A reciprocating pump consisting of two consisting of two cylinders placed side by side and connected to the same suction and discharge pipe; the pistons move so that one exerts suction while the other exerts pressure, with the result that the discharge from the pump is continuous.

Dynamic Head – (1) When there is flow: (2) the head against which a pump works. (3) That head of fluid which would produce statically the pressure of a moving fluid.

Efficiency – The relative results obtained in any operation in relation to the energy or effort required to achieve such results. It is the ratio of the total output to the total input, expressed as a percentage.

Effluent – (1) A liquid which flows out of a containing space. (2) Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial treatment plant, or part thereof. (3) An outflowing branch of a main stream or lake.

Effluent Weir – A weir at the outflow end of a sedimentation basin or other hydraulic structure.

End Point – The stage in a titration at which equivalence is attained and revealed by a change that can be observed or measured, such as color development, formation of a precipitate, or reaching a specified pH.

Escherichia Coli (E. Coli.) – One of the species of bacteria in the coliform group. Its presence is considered indicative of fresh fecal contamination.

Excess Sludge – The sludge produced in an activated sludge treatment plant that it not needed to maintain the process and is withdrawn from circulation.

Exfiltration – The quantity of wastewater which leaks to the surrounding ground through unintentional openings in a sewer. Also, the process whereby this leaking occurs.

Explosimeter – An instrument designed to give warning of an explosive mixture of oxygen and combustible gas.

Extended Aeration – A modification of the activated sludge process which provides for aerobic sludge digestion within tne aeration system. The concept envisages the stabilization of organic matter under aerobic conditions and disposal of the end products into the air as gases and with the plant effluent as finely divided suspended matter and soluble matter.

Fahrenheit – A temperature scale in which 32 degrees marks the freezing point, and 212 degrees the boiling point of water at a 760 mm barometric pressure. To convert to centigrade (Celsius), subtract 32, and multiply by 5/9.

Final Effluent – The effluent from the final treatment unit of a wastewater treatment plant.

Fine Rack – A relative term, but generally, a rack which has clear spaces of one inch or less between its bars.

Five-Day BOD – That part of oxygen demand associated with biochemical oxidation of carbonaceous, as distinct from nitrogeneous, material. It is determined by allowing biochemical oxidation to proceed, under conditions specified in Standard Methods, for five days. See Firststage Biochemical Oxygen Demand.

Fixed Solids – The residue remaining after ignition of suspended or dissolved matter according to Standard Methods.

Flame Arrester – A device incorporating a fine-mesh wire screen or tube bundle inserted in a vent or pipe and designed to resist the flashback of flame.

Flanged Pipe – A pipe provided with flanges so that the ends can be joined together by means of bolts.

Flash Mixer – A device for quickly dispersing chemicals uniformly throughout a liquid.

Flocculating Tank – A tank used for the formation of floc by the gentle agitation of liquid suspensions, with or without the aid of chemicals

Flocculation – In water and wastewater treatment, the agglomeration of colloidal and finely divided suspended matter after coagulation by gentle stirring by either mechanical or hydraulic means. In biological wastewater treatment where coagulation is not used, agglomeration may be accomplished biologically.

Flocculation Agent – A coagulating substance which, when added to water forms a flocculent precipitate which will entrain suspended matter and expedite sedimentation; examples are alum, ferrous sulfate, and lime.

Flocculator – (1) A mechanical device to enhance the formation of floc in a liquid. (2) An apparatus for the formation of floc in water and wastewater.

Flotation – The raising of suspended matter to the surface of the liquid in a tank as scum --by aeration, the evolution of gas, chemicals, electrolysis, heat, or bacterial decomposition-- and the subsequent removal of the scum by skimming.

Flow Regulator – A structure installed in a canal, conduit, or channel to control the flow of water wastewater at intake or to control the water level in a canal, channel, or treatment unit. Also see rate-of-flow controller, regulator.

Flume – An open channel for transporting liquids.

Foot Valve – A valve placed in the bottom of the suction pipe of a pump, which opens to allow water to enter the suction pipe, but closes to prevent water from passing out of it at the bottom end.

Force Main – A pressure pipe joining the pump discharge at a water or wastewater pumping station with a point of gravity flow.

Free Available Chlorine – The amount of chlorine available as dissolved gas, hypochlorous acid, or hypochlorite ion that is not combined with an amine or other organic compound.

Free Available Residual Chlorine – That portion of the total residual chlorine remaining in water or wastewater at the end of a specified contact period which will react chemically and biologically as hypochlorous acid or hypochlorite ion.

Free Residual Chlorination – The application of chlorine or chlorine compounds to water or wastewater to produce a free available chlorine residual directly or through the destruction of ammonia or certain organic nitrogenous compounds.

Fresh Sludge – Sludge in which decomposition is little advanced.

Fresh Wastewater – Wastewater of recent origin containing dissolved oxygen.

Fungi – Small non-chlorophyll bearing plants which lack roots, stems, or leaves, which occur (among other places), in water, wastewater, or wastewater effluents and grow best in the absence of light. Their decomposition after death may cause disagreeable tastes and odors in water; in some wastewater treatment processes, they are helpful and in others they are detrimental.

Gas Dome – In sludge-digestion tanks, usually a steel cover floating entirely or in part on the liquid sludge.

Gas Vent – (1) A passage to permit the escape of gases. (2) An opening which allows gas liberated in an Imhoff tank sludge chamber to reach the atmosphere without passing up through the wastewater in the settling chamber.

Gate Valve – A valve in which the closing element consists of a disk which slides over the opening or cross-sectional area through which water passes, and fits tightly against it.

Globe Valve – A valve having a round, ball-like shell and horizontal disk.

Grab Sample – A single sample of wastewater taken at neither set time nor flow.

Graduated Cylinder – A cylinder designed to measure volume in discreet increments.

Gravimetric – Of or pertaining to measurement by weight.

Grease – In wastewater, a group of substances including fats, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and certain other nonfatty materials. The type of solvent and method used for extraction should be stated for quantitation.

Grease Skimmer – A device for removing floating grease or scum from the surface of wastewater in a tank.

Grit – The heavy suspended mineral matter present in water or wastewater, such as sand, gravel, cinders.

Grit Chamber – A detention chamber or an enlargement of a sewer designed to reduce the velocity of flow of the liquid to permit the separation of mineral from organic solids by differential desimentation.

Head – The height of the free surface of fluid above any point in a hydraulic system; a measure of the pressure or force exerted by the fluid.

Heat Exchanger – A device providing for the transfer of heat from a fluid flowing in tubes to another fluid outside the tubes, or vice versa.

Heavy Metals – Metals that can be precipitated by hydrogen sulfide in acid solution, for example, lead, silver, gold, mercury, bismuth, copper.

High–Rate Digestion – Accelerated anaerobic digestion resulting primarily from thorough mixing of digester contents. May be enhanced by thermophilic digestion.

High-Rate Filter – A trickling filter operated at a high average daily dosing rate, usually between 10 and 40 mgd/acre including any recirculation of effluent.

Horizontal Pump – (1) A reciprocating pump in which the piston or plunger moves in a horizontal direction. (2) A centrifugal pump in which the pump shaft is in a horizontal position.

Humus Sludge – Sludge deposited in final or secondary settling tanks following trickling filters or contact beds.

Hydraulic Jump – An abrupt rise in water surface which may occur in an open channel when water flowing at a high velocity is retarded.

Hydrogen–Ion Concentration – The weight of hydrogen ion in moles per liter of solution. Commonly expressed as the pH value, which is the logarithm of the reciprocal of the hydrogen-ion concentration.

Hydrometer – An instrument designed to measure the specific gravity of liquids or slurries either in specific gravity units or degrees baume'.

Hydrostatic Sludge Removal – The discharge of sludge from hopper-bottomed sedimentation tanks by use of the hydrostatic pressure of the wastewater above the sludge oulet.

Imhoff Cone – A cone-shaped graduated glass vessel used to measure the approximate volume of settleable solids in various liquids of wastewater origin during various settling times.

Imhoff Tank – A deep, two-storied wastewater tank originally patented by Karl Imhoff. It consists of an upper continuous-flow sedimentation chamber and a lower sludge-digestion chamber. The floor of the upper chamber slopes steeply to trapped slots through which solids may slide into the lower chamber. The lower chamber receives no fresh wastewater directly, but is provided with gas vents and with means for drawing digested sludge from near the bottom.

Immediate Biochemical Oxygen Demand – (1) The initial quantity of oxygen used by polluted liquid immediately upon being introduced into water containing dissolved oxygen. It may be exercised by end products of prior biochemical action or by chemical substances avid for oxygen. (2) In the standard laboratory procedure, the apparent BOD for fifteen minutes at 20 degrees Centigrade.

Impeller – A rotating set of vanes designed to impel rotation of a mass of fluid.

Industrial Wastes – The liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

Infiltration – The quantity of groundwater that leaks into a pipe through joints, porous walls, or breaks.

Infiltration Rate – (1) The rate at which water enters the soil or other porous material under a given condition. (2) The rate at which infiltration takes place, expressed in depth of water per unit time, usually in inches per hour. (3) The rate, usually expressed in cubic feet per second or million gallons per day per mile of waterway at which groundwater enters an infiltration ditch or gallery, drain, sewer, or other underground conduit.

Influent – Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant, or any unit thereof.

Inorganic Matter – Chemical substances of mineral origin, or more correctly, not of basically carbon structure.

Intermediate Treatment – The removal of a high percentage of suspended solids and a substantial percentage of colloidal matter, but little dissolved matter.

Lagoon – A pond containing raw or partially treated wastewater in which aerobic or anaerobic stabilization occurs.

Lagooning – The placement of solid or liquid material in a basin, reservoir, or artificial impoundment for purposes of storage, treatment, or disposal.

Lime – Any of a family of chemicals consisting essentially of calcium hydroxide made from limestone (calcite) which is composed almost wholly of calcium carbonate or a mixture of calcium and magnesium carbonate.

Liquid Chlorine – Elemental chlorine placed in a liquid state by a combination of compression and refrigeration of dry, purified chlorine gas. Liquid chlorine is shipped under pressure in steel containers.

Loss of Head – The difference between the total heads at two points in a hydraulic system.

Low-Rate Filter – A trickling filter designed to receive a small load of BOD per unit volume of filtering material and to have a low dosage rate per unit of surface area, usually one to four million gallons per day per acre, and generally without recirculation. Organic loading (BOD) rate is usually in the range of 5 to 25lb/1,000 cu ft. Also called standard-rate filter.

Maintenance – The upkeep necessary for efficient operation of physical properties. It involves labor and materials, but is not to be confused with replacement or retirement.

Manometer – An instrument for measuring pressure. It usually consists of a U-shaped tube containing a liquid, the surface of which in one end of the tube moves proportionally with changes in pressure on the liquid in the other end. Also, a tube type of differential pressure gage.

Mechanical Aeration – (1) The mixing, by mechanical means, of wastewater and activated sludge in the aeration tank of the activated sludge process to bring fresh surfaces of liquid into contact with the atmosphere. (2) The introduction of atmospheric oxygen into a liquid by the mechanical action of paddle, paddle wheel, spray or turbine mechanisms.

Mechanical Aerator – A mechanical device for the introduction of atmospheric oxygen into a liquid. See Mechanical Aeration.

Mechanical Rake – A machine-operated mechanism used for cleaning debris from racks located at the intakes of conduits supplying water to hydroelectric power plants, to water supply systems, or for other uses, and conveying wastewater to pumps or treatment processes.

Mesophilic Range – Operationally, that temperature range most conducive to the maintenance of optimum digestion by medophilic bacteria, generally accepted as between 27 degrees and 32 degrees Centigrade (80 degrees and 90 degrees Fahrenheit). See Mesophilic Digestion.

Methane Fermentation – Fermentation resulting in conversion of organic matter into methane gas.

Microbial Activity – Chemical changes resulting from the metabolism of living organisms. Biochemical action.

Milligrams Per Liter – A unit of the concentration of water or wastewater constituent. It is 0.001 g of the constituent in 1,000 ml of water. It has replaced the unit formerly used commonly, parts per million, to which it is approximately equivalent, in reporting the results of water and wastewater analysis.

Mixed–Flow Pump – A centrifugal pump in which the head is developed partly by centrifugal force and partly by the lift of the vanes on the liquid. This type of pump has a single inlet impeller; the flow enters axialiy and leaves axially and radially.

Mixed Liquor – A mixture of activated sludge and organic matter undergoing activated sludge treatment in the aeration tank.

Mixing Tank – A tank designed to provide a thorough mixing of chemicals introduced into liquids or of two or more liquids of different characteristics.

Modified Aeration – A modification of the activated sludge process in which a shortened period of aeration is used with a reduced quantity of suspended solids in the mixed liquor.

Mud Valve – A plug valve for draining out sediment, inserted in the bottom of settling tanks.

Multistage Pump – A centrifugal pump with two or more sets of vanes or impellers connected in series in the same casing. Such a pump may be designated as two-stage, three-stage, or more, according to the number of sets of vanes used.

Needle Valve – A valve with a circular outlet through which the flow is controlled by means of a tapered needle which extends through the outlet, reducing the area of the outlet as it advances and enlarging the area as it retreats.

Nitrification – The conversion of nitrogenous matter into nitrates by bacteria.

Nitrogen Cycle – A graphical presentation of the conservation of matter in nature, from living animal matter through dead organic matter, various stages of decomposition, plant life, and the return of living animal matter, showing changes which occur in course of the cycle. It is used to illustrate biological action and also aerobic and anaerobic acceleration of the transformation of this element by wastewater and sludge treatment.

Nonclogging Impeller – An impeller of the open, closed, or semiclosed type designed with large passages for passing large solids.

Nonsettleable Solids – Wastewater matter that will stay in suspension for an extended period of time. Such period may be arbitrarily taken for testing purposes as one hour.

Notched Weir – A weir having a substantial width of crest broken at intervals by a notch of known hydraulic characteristics, usually a V-notch. Also see Broad-Crested Weir.

Odor Control – In wastewater treatment, the prevention or reduction of objectionable odors by chlorination, aeration, or other processes or by making with chemical aerosols.

Open Channel – Any natural or aritficial waterway or conduit in which water flows with a free surface.

Organic Matter – Chemical substances of animal or vegetable origin, or more correctly, of basically carbon structure, comprising compounds consisting of hydrocarbons and their derivatives.

Organic Overload – Influent BOD loading in excess of design capacity on any unit.

Orthotolidine Test – A technique for determining residual chlorine in water by using orthotolidine reagent and choloimetric standards. It is used for routine measurement; however, its accuracy is affected by interfering substances and color.

Outfall Sewer – A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge.

Overflow Rate – One of the criteria for the design of settling tanks in treatment plants; expressed in gallons per day per square foot of surface area in the settling tank.

Overflow Weir – Any device or structure over which any excess water or wastewater beyond the capacity of the conduit or container is allowed to flow or waste. See Diverting Weir.

Overhead – Those elements of indirect cost necessary to produce an article or perform a service of such nature that the amount applied to each unit of product or service cannot be determined readily or accurately and is thus usually allocated on some arbitrary basis. Normally, overhead relates to those objects of expenditure which do not become an integral part of the finished product or service, such as rent, light, supplies, management, and supervision.

Oxidation – The addition of oxygen to a compound. More generally, any reaction which involves the loss of electrons from an atom.

Oxidation Pond – A basin used for retention of wastewater before final disposal, in which biological oxidation of organic material is effected by natural or artificially accelerated transfer of oxygen to the water from air.

Oxidation Rate – The rate at which the organic matter in wastewater is stabilized.

Oxygenation Capacity – In treatment processes, a measure of the ability of an aerator to supply oxygen to a liquid.

Oxygen Consumed – A measure of the oxygen-consuming capability of inorganic and organic matter present in water or wastewater. See Chemical Oxygen Demand.

Oxygen Deficiency – (1) The additional quantity of oxygen required to satisfy the oxygen requirement in a given liquid. Usually expressed in milligrams per liter. (2) Lack of oxygen.

Oxygen Demand – (1) The quantity of oxygen utilized in the biochemical oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions. See BOD.

Oxygen Depletion – Loss of dissolved oxygen from water or wastewater resulting from biochemical or chemical action.

Oxygen Reduction Potential Meter – An electrical measuring device designed to show whether the electrical charge of a solution is positive or negative.

Oxygen-Sag Curve – A curve that represents the profile of dissolved oxygen content along the course of a stream, resulting from deoxygenation associated with biochemical oxidation of organic matter and reoxygenation through the absorption of atmospheric oxygen and through biological photosynthesis Also called dissolved-oxygen-sag-curve.

Oxygen Saturation – The maximum quantity of dissolved oxygen that liquid of given chemical characteristics, in equilibrium with the atmosphere, can contain at a given temperature and pressure.

Oxygen Utilization – (1) The oxygen consumed or utilized to support aerobic biological treatment processes. (2) The oxygen used to support combustion in the degradation of sludge by incineration or wet air oxidation.

Ozone – Oxygen in molecular form with three atoms of oxygen forming each molecule (O_3).

Parshall Flume – A calibrated device developed by Parshall for measuring the flow of liquid in an open conduit. It consists essentially of a contracting length, a throat, and an expanding length. At the throat is a sill over which the flow passes at Belanger's critical depth. The upper and lower heads are each measured at a definite distance from the sill. The lower head need not be measured unless the sill is submerged more than about sixty-seven percent.

Pathogenic Bacteria – Bacteria which may cause disease in the host organisms by their parasitic growth.

Pathogens – Pathogenic or disease-producing organisms.

Peak Load – The maximum rate of flow of wastewater to a pumping station or treatment plant. Also called peak demand.

Peripheral Flow – Flow of water or other liquid parallel to the circumference or periphery of a circular tank or other circular structure. Also called circumferential flow.

Peripheral Weir – The outlet weir extending around the inside of the circumference of a circular settling tank, over which the effluent discharges.

Pet Cock – A small cock used to drain a cylinder, fitting, valve, or similar device.

pH – The reciprocal of the logarithm of the hydrogen-ion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water, for example, has a pH value of seven and a hydrogen-ion concentration of ten to the negative seven exponent.

Phenolic Compounds – Hydroxy derivatives of benzene. The simplest phenolic compound is hydroxy benzene, C_6H_5OH.

Phenol Wastes – Industrial wastes containing phenols, derived chiefly from coking processes and oil refineries.

Photosynthesis – The synthesis of complex organic materials, especially carbohydrates, from carbon dioxide, water, and inorganic salts, with sunlight as the source of energy, and with the aid of a catalyst such as chlorophyll.

Physical Analysis – The examination of water and wastewater to determine physical characteristics such as temperature, turbidity, color, odors, taste.

Pipe Gallery – (1) Any conduit for pipe, usually of a size to allow a man to walk through. (2) A gallery provided in a treatment plant for the installation of the conduits and valves and for a passageway to provide access to them.

Pipeline – Pipes jointed to provide a conduit through which fluids flow.

Pipette – A device for measuring and/or transfering of accurate amounts of liquids.

Piston Pump – A reciprocating pump wherein the cylinder is tightly fitted with a reciprocating piston.

Plain Sedimentation – The sedimentation of suspended matter in a liquid, unaided by chemicals or other special means and without provision for the decomposition of deposited solids in contact with the wastewater.

Plate Count – Number of colonies of bacteria grown on selected solid media at a given temperature and incubation period, usually expressed in number of bacteria per milliliter of sample.

Plug Valve – A valve in which the movable control element is a cylindrical or conical plug, in contrast to a flat disk.

Plunger Pump – A reciprocating pump having a plunger that does not come in contact with the cylinder walls, but enters and withdraws from it through packing glands. Such packing may be inside or outside the center, according to the design of the pump.

Pneumatic Ejector – A device for raising wastewater, sludge, or other liquid by alternately admitting it through an inward-swinging check valve into the bottom of an airtight pot and then discharging it through an outward-swinging check valve by admitting compressed air to the pot above the liquid.

Pollution – A condition created by the presence of harmful or objectionable material in water.

Pollutional Load – (1) The quantity of material in a waste stream that requires treatment or exerts an adverse effect on the receiving system. (2) The quantity of material carried in a body of water that exerts a detrimental effect on some subsequent use of that water.

Positive Head – The energy possessed per unit weight of a fluid, due to its elevation above some datum.

Post-Chlorination – The application of chlorine to water or wastewater subsequent to any treatment, including prechlorination.

Preaeration – A preparatory treatment of wastewater consisting of aeration to remove gases, add oxygen, promote flotation of grease, and aid coagulation.

Pre-Chlorination – The application of chlorine to water or wastewater prior to any treatment.

Precipitate – The separation from solution as a precipitate. The substance precipitated.

Precipitation – The total measurable supply of water received directly from clouds, as rain, snow, hail, or sleet; usually expressed as depth in a day, month, or year, and designated as daily, monthly, or annual precipitation.

Preliminary Treatment – (1) The conditioning of a waste at its source before discharge, to remove or to neutralize substances injurious to sewers and treatment processes, or to effect a partial reduction in load on the treatment process. (2) In the treatment process unit operation, such as screening and comminution, that prepare the liquor for subsequent major operations.

Pressure-Reducing Valve – A valve with a horizontal disk for reducing pressures automatically, according to the setting of the pressure-regulating valves.

Pressure-Regulating Valve – A valve placed at either end of a pressure-regulating apparatus inserted in a water main to regulate the pressure in a water line, either upstream or downstream from the valve.

Pressure Regulator – A device for controlling pressure in a pipeline or pressurized tank, such as a pressure-regulating valve or a pump drive-speed controller.

Pressure-Relief Valve – A valve that opens automatically to ample area when the pressure reaches an assigned limit, to relieve the stress on a pipeline.

Primary Settling Tank – The first settling tank for the removal of settleable solids through which wastewater is passed in a treatment works.

Primary Sludge – Sludge obtained from a primary settling tank.

Primary Treatment – (1) The first major (sometimes the only) treatment in a wastewater treatment workd, usually sedimentation. (2) The removal of a substantial amount of suspended matter but little or no colloidal and dissolved matter.

Priming – (1) The first filling with water of a canal, reservoir, or other structure built to contain water. (2) The action of starting the flow in a pump or siphon.

Protozoa – Small one-celled animals including amoebas, ciliates, and flagellants.

Psychoda – A small gray fly prevalent arount trickling filters. Their larvae live in the zoogloeal film on the filter stones and may serve some useful purpose, but they are primarily a nuisance.

Pump – A mechanical device for causing flow, for raising or lifting water or other fluid, or for applying pressure to fluids.

Pump Efficiency – The ratio of energy conwerted into useful work to the energy applied to the pump shaft, or the energy difference in the water at the discharge and suction nozzles divided by the power input at the pump shaft.

Pumping Head – The sum of the static head and friction head on a pump discharging a given quantity of water.

Pumping Station – A station housing relatively large pumps and their appurtenances. Pump house is the usual term for shelters for small water pumps.

Pump Pit – A dry well or chamber below ground level in which a pump is located.

Pump Primer – A vacuum pump attached to the suction end of a pump for priming the pump automatically.

Pump Stage – The number of impellers in a centrifugal pump; for example, a single-stage pump has one impeller; a two-stage pump has two impellers.

Pump Stroke – The lineal distance traveled by the piston or plunger or a reciprocating pump through one-half of its cycle of movement.

Quicklime – A calcined material the major part of which is calcium oxide or calcium oxide in natural association with a lesser amount of magnesium oxide. It is capable of slaking with water.

Rack – A device fixed in place and used to return or remove suspended or floating solids from wastewater and composed of parallel bars evenly spaced.

Rakings – The screenings or trash removed from bar screens cleaned manually or by mechanical rakes.

Rate-of-Flow Controller – An automatic device that controls the rate of flow of a fluid.

Rate-of-Flow Recorder – A recorder for registering the rate of flow of water, generally, used with a rapid sand filter.

Raw Sludge – Settled sludge promptly removed from sedimentation tanks before decomposition has much advance. Frequently referred to as undigested sludge.

Raw Wastewater – Wastewater before it receives any treatment.

Reaeration – The absorption of oxygen into water under conditions of oxygen deficit.

Receiving Body of Water – A natural watercourse, lake, or ocean into which treated or untreated wastewater is discharged.

Reciprocating Pump – A type of displacement pump consisting essentially of a closed cylinder containing a piston or plunger, as the displacing mechanism, drawing liquid into the cylinder through an inlet valve and forcing it out through an outlet valve. When the piston acts on the liquid in one end of the cylinder, the pump is termed single-action, and when it acts in both ends, it is termed double-action.

Recirculation – (1) In the wastewater field, the refiltration of all or a portion of the effluent in a trickling filter to maintain a uniform high rate through the filter. Return of a portion of the effluent to maintain minimum flow is sometimes called recycling. (2) The return of effluent to the incoming flow.

Recycling – An operation in which a substance is passed through the same series of processes, pipes, or vessels more than once.

Reducer – A pipe or pipe fitting having a smaller-size opening at one end than at the other.

Reducing Tee – Any tee having two different sizes of openings. It may reduce on the run or branch.

Relief Valve – A valve that releases air from a pipeline automatically without loss of water, or introduces air into a line automatically if internal pressure becomes less than that of the atmosphere.

Repairs – An element of maintenance, as distinguished from replacement or retirement.

Representative Sample – A small quantity of a substance that is representative of the entire substance.

Residual Chlorine – Chlorine remaining in water or wastewater at the end of a specified contact period as combined or free chlorine. See Free Available Residual Chlorine.

Residual Oxygen – The dissolved oxygen content of a stream after deoxygenation has begun.

Returned Sludge – Settled activated sludge returned to mix with incoming raw or primary settled wastewater.

Riprap – Broken stone or boulders placed compactly or irregularly on dams, levees, dikes, or similar embankments for protection of earth surfaces against the action of waves or currents.

Rotameter – A fluid-flow-measuring device utilizing a float, suspended in an upflowing fluid stream through a progressively increasing diameter tube.

Rotary Distributor – A movable distributor made up of horizontal arms that extend to the edge of the circular trickling filter bed, revolve about a central post, and distribute liquid over the bed through orifices in the arms. The jet action of the discharging liquid normally supplies the motive power.

Roughing Filter – A wastewater filter of relatively coarse material operated at a high rate to afford preliminary treatment.

Runoff – That part of the precipitation which runs off the surface of a drainage area and reaches a stream or other body of water or a drain or sewer.

Sampler – A device used with or without flow measurement to obtain an aliquot portion of water or waste for analytical purposes. May be designed for taking single sample (grab), composite sample, continuous sample, periodic sample.

Sanitary Wastewater – (1) Domestic wastewater with storm and surface water excluded.
(2) Wastewater discharging from the sanitary conveniences of dwelling (including apartment houses and hotels), office buildings, industrial plants, or institutions.
(3) The water supply of a community after it has been used and discharged into a sewer.

Screen – A device with openings, generally of uniform size, used to retain or remove suspended or floating solids in flowing water or wastewater and to prevent them from entering an intake or passing a given point in a conduit. The screening element may consist of parallel bars, rods, wires, grating, wire mesh, or perforated plat, and the openings may be of any shape, although they are usually circular or rectangular.

Screen Chamber – A chamber in which screens are installed.

Screening – The removal of relatively coarse floating and suspended solids by straining through racks or screens.

Screenings – Material removed from liquids by screens.

Screenings Grinder (Comminutor) – A device for grinding, shredding, or macerating material removed from wastewater by screens.

Screenings Shredder – A device that disintegrates screenings.

Scum – (1) The layer of film of extraneous or foreign matter that rises to the surface of a liquid and is formed there. (2) A residue deposited on a container or channel at the water surface. (3) A mass of solid matter that floats on the surface.

Scum Baffle – A vertical baffle dipping below the surface of wastewater in a tank to prevent the passage of floating matter. Also called scum board.

Scum Collector – A mechanical device for skimming and removing scum from the surface of a settling tank.

Scum Trough – A trough placed in a primary settling tank to intercept scum and convey it out of the tank.

Secondary Settling Tank – A tank through which effluent from some prior treatment process flows for the purpose of removing settleable solids.

Secondary Wastewater Treatment – The treatment of wastewater by biological methods after primary treatment by sedimentation.

Second-Stage Biochemical Oxygen Demand – That part of the oxygen demand associated with the biochemical oxidation of nitrogenous material. As the term implies, the oxidation of the nitrogenous materials usually does not start until a portion of the carbonaceous material has been oxidized during the first stage.

Sedimentation – The process of subsidence and deposition of suspended matter carried by water, wastewater, or other liquids, by gravity. It is usually accomplished by reducing the velocity of the liquid below the point at which it can transport the suspended material. Also called settling.

Sedimentation Tank – A basin or tank in which water or wastewater containing settleable solids is retained to remove by gravity a part of the suspended matter. Also called sedimentation basin, settling basin, settling tank.

Separate Sludge Digestion – The digestion of sludge in tanks separate from that in which it had been allowed to settle.

Septicity – A condition produced by growth of anaerobic organisms.

Sptic Sludge – Sludge from a septic tank or partially digested sludge from an Imhoff tank or sludge-digestion tank.

Septic Wastewater – Wastewater undergoing putrefaction under anaerobic conditions.

Settleability Test – A determination of the settleability of solids in a suspension by measuring the volume of solids settled out of a measured volume of sample in a specified interval of time, usually reported in milliliters per liter. Sometimes identified as the Imhoff cone test.

Settleable Solids – (1) That matter in wastewater which will not stay in suspension during a preselected settling period, such as one hour, but either settles to the bottom or floats to the top. (2) In the Imhoff cone test, the volume of matter that settles to the bottom of the cone in one hour.

Settled Wastewater – Wastewater from which most of the settleable solids have been removed by sedimentation. Also called clarified wastewater.

Settling Tank – A basin or bank in which water or wastewater containing settleable solids is retained to remove by gravity a part of the suspended matter. Also called sedimentation basin, sedimentation tank, settling basin.

Settling Velocity – The velocity at which subsidence and deposition of the settleable suspended solids in water and wastewater will occur.

Sewage Charge – A service charge made for providing wastewater colleciton and/or treatment service. A specific charge in contrast to an ad volorem tax.

Sewage Gas – (1) Gas resulting from the decomposition of organic matter in wastewater. (2) Gas produced during the digestion of sludge.

Sewage Rate – A charge, or a schedule of charges, for the collection, or the collection and treatment, of wastewater to users connected to the system, based on water consumption, wastewater flow, wastewater strength, number and types of plumbing fixtures, or some combination.

Sewer – A pipe or conduit that carries wastewater or drainage water.

Sewerage – System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use.

Sewer Appurtenances – Structures, devices, and appliances, other than pipe or conduit, that are integral parts of a sewer system.

Shear Gate – A pivoted slide, without guides, held in place by the pressure of the water and seating lugs. This type of gate is not watertight for reversed pressure.

Short-Circuiting – A hydraulic condition occurring in parts of a tank where the time of travel is less than the flowing-through time.

Side Water Depth – The depth of water measured along a vertical exterior wall.

Siphon – A closed conduit, a portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilizes atmospheric pressure to effect or increase the flow of water through the conduit.

Skimming – The process of removing floating grease or scum from the surface of wastewater in a tank.

Skimmings – Grease, solids, liquids, and scum skimmed from wastewater settling tanks.

Slake – To become mixed with water so that a true chemical combination takes place, as in the slaking of lime.

Slimes – Substances of viscous organic nature, usually formed from microbiological growth.

Slot – (1) A narrow opening. (2) In an Imhoff tank, the opening provided for deflection of gas (see Gas Vent) or for the passage of deposited solids into the digestion chamber.

Sloughing – The disattachment of slime and solids accumulated on the media of trickling filters and contact areas. Sloughed material usually appears in the effluent.

Sludge – (1) The accumulated solids separated from liquids, such as water or wastewater, during processing, or deposits on bottoms of streams, or other bodies of water. (2) The precipitate resulting from chemical treatment, coagulation, or sedimentation of water or wastewater.

Sludge Age – In the activated sludge process, a measure of the length of time a particle of suspended solids has been undergoing aeration, expressed in days. It is usually computed by dividing the weight of the suspended solids in the aeration tank by the daily addition of new suspended solids having their origin in the raw waste.

Sludge Bank – Accumulated deposits of solids of wastewater or organic origin on the bottom, banks, edges, or shores of waterways or open water.

Sludge Bed – An area comprising natural or artificial layers of porous material on which digested wastewater sludge is dried by drainage and evaporation. A sludge bed may be open to the atmosphere or covered, usually with a greenhouse-type superstructure. Also called sludge drying bed.

Sludge Blanket – Accumulation of sludge hydrodynamically suspended within an enclosed body of water or wastewater.

Sludge Bulking – A phenomenon that occurs in activated sludge plants whereby the sludge occupies excessive volumes and will not concentrate readily.

Sludge Cake – The sludge that has been dewatered by a treatment process to a moisture content of sixty to eighty five percent, depending on type of sludge and manner of treatment.

Sludge Circulation – The overturning of sludge in sludge-digestion tanks by mechanical or hydraulic means or by use of gas recirculation to disperse scum layers and to promote digestion.

Sludge Collector – A mechanical device for scraping the sludge on the bottom of a settling tank to a sump from which it can be drawn.

Sludge Concentration – Any process of reducing the water content of sludge that leaves the sludge in a fluid condition.

Sludge Conditioning – Treatment of liquid sludge before dewatering to facilitate dewatering and enhance drainability, usually by the addition of chemicals.

Sludge Density Index – The reciprocal of the sludge volume index multiplied by one hundred.

Sludge Deposit – A deposit of solids of wastewater origin.

Sludge Digestion – The process by which organic or volatile matter in sludge is gasified, liquified, mineralized, or converted into more stable organic matter through the activities of either anaerobic or aerobic organisms.

Sludge-Digestion Gas – Gas resulting from the decomposition of organic matter in sludge removed from wastewater and placed in a tank to decompose under anaerobic conditions. Also see Sewage Gas, Sludge Digestion.

Sludge Excess – The sludge produced during recirculation in an activated sludge treatment plant that is not needed to maintain the process and not returned to the aeration tank, but is withdrawn from circulation.

Sludge Foaming – An increase in the gas in sludge in Ir ff and separate digestion tanks, causing large quantities of froth, scum, and sludge to rise and overflow from openings at or near the top of the tanks.

Sludge-Gas Holder – A tank used to store gas collected from sludge-digestion tanks, for the purpose of stabilizing the flow of gas to the burners, maintaining a nearly constant pressure, and supplying gas during periods when the digestion tanks are temporarily out of service or when gas production is low.

Sludge Index – Properly called sludge volume index (SVI). It is the volume in milliliters occupied by one gram of activated sludge after settling of the aerated liquid for thirty minutes.

Sludge Lagoon – A basin used for the storage, digestion, or dewatering of sludge.

Sludge Reaeration – The continuous aeration of sludge after its initial aeration for the purpose of improving or maintaining its condition.

Sludge Treatment – The processing of wastewater sludges to render them innocuous. This may be done by aerobic or anaerobic digestion followed by drying on sand beds, filtering, and incineration, filtering and drying, or wer air oxidation.

Sludge Volume Index (SVI) – The ratio of the volume in milliliters of sludge settled from a one thousand milliliter sample in thirty minutes to the concentration of mixed liquor in milligrams per liter multiplied by one thousand.

Snubber – A muffler designed to reduce the sound on blower intakes.

Solium Aluminate – A coagulating chemical and softening agent ($Na_2Al_2O_4$) often used in lieu of or in conjunction with alum.

Solium Hypochlorite – A water solution of sodium hydroxide and chlorine, in which solium hypochlorite is the essential ingrer

Solids Reduction – The conversion of the more active volatile solid matter into water and gases resulting in a lower final volume of volatile solids.

Solids-Retention Time – The average residence time of suspended solids in a biological waste treatment system, equal to the total weight of suspended solids in the system divided by the total weight of suspended solids leaving the system per unit of time (usually per day).

Solution Feeder – A feeder for dispensing a chemical or other material in the liquid or dissolved state to water or wastewater at a rate controlled manually or automatically by the quantity of flow. The constant rate is usually volumetric.

Sparger – An air diffuser designed to give large bubbles, used singly or in combination with mechanical aeration devices.

Specific Gravity – The ratio of the mass of a body to the mass of an equal volume of water.

Spiral Air-Flow Diffusion – A method of diffusing air in an aeration tank of the activated sludge process where, by means of properly designed baffles and the proper location of diffusers, a spiral or helical movement is given to the air and the tank liquor.

Stabilization Pond – A type of oxidation pond in which biological oxidation of organic matter is effected by natural or artificially accelerated transfer of oxygen to the water from air.

Stable Effluent – Treated wastewater that contains enough oxygen to satisfy its oxygen demand.

Stage Aeration – Division of activated sludge treatment into stages with intermediate settling tanks and return of sludge in each stage.

Stale Wastewater – Wastewater containing little or no oxygen, but as yet free from putrefaction.

Standard-Rate Filter – A type of trickling filter in which both hydraulic and organic loadings are relatively low, usually built to operate without recycling or recirculation of wastewater.

Static Head – (1) The total head without reduction for velocity head or losses; for example, the difference in elevation of head-water, and tail-water of a power plant. (2) The vertical distance between the free level of the source of supply and the point of free discharge or the level of the free surface.

Static Suction Head – The vertical distance from the source of supply when its level is above the pump to the center line of the pump.

Step Aeration – A procedure for adding increments of settled wastewater along the line of flow in the aeration tanks of an activated sludge plant.

Stilling Well – A separate quiescent chamber connected to an open channel flow. Used to house float of flow meter device.

Stokes Law – A mathematical equation for determining the settling rate of particles.

Stop Plank – A removable wooden plank that is placed in a groove or rack to block off or permit the flow of a liquid from one compartment or channel to another.

Storm Flow – That portion of the precipitation which leaves the drainage area in a comparatively short time on or near the surface.

Storm Sewer – A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes.

Stuck Digestor – A stuck digestor does not decompose the organic matter properly. Some refer to it as constipated. It is characterized by low gas production, high volatile acid/alkalinity relationship, and poor liquid-solids separation. A digestor in a stuck condition is sometimes called a "sour" digestor.

Suction Pipe – The inlet pipeline of a pump.

Suction Pit – A walled pit in which the suction pipe or inlet openings of a pump are placed. Sometimes called a sump or wet well.

Sulfur Bacteria – Bacteria capable of using dissolved sulfur compounds in their growth; bacteria deriving energy from sulfur or sulfur compounds.

Sump – (1) A tank or pit that receives drainage and store it temporarily, and from which the drainage is pumped or ejected. (2) A tank or pit that receives liquids.

Sump Pump – A mechanism used for removing water or wastewater from a sump, or wet well; it may be energized by air, water, steam, or electric motor. Ejectors and submerged centrifugal pumps, either float– or manually controlled, are often used for the purpose.

Supernatant Liquor – (1) The liquor overlying deposited solids. (2) The liquid in a sludge-digestion tank that lies between sludge at the bottom and floating scum at the top.

Surface Aeration – The absorption of air through the surface of a liquid.

Suspended Solids – Solids that either float on the surface of, or are in suspension in, water, wastewater, or other liquids, and which are largely removable by laboratory filtering. See Suspended Matter.

Sutro Weir – A proportional weir.

Tapered (Step) Aeration – The method of supplying varying amounts of air into the different parts of an aeration tank in the activated sludge process, more at the inlet, less near the outlet, in approximate proportion to the oxygen demand of the mixed liquor under aeration.

Torque – A twisting force on a drive shaft.

Total Dynamic Head – The difference between the elevation corresponding to the pressure at the discharge flange of a pump and the elevation corresponding to the vacuum or pressure at the suction flange of the pump, corrected to the same datum plane, plus the velocity head at the discharge flange of the pump, minus the velocity head at the suction flange of the pump.

Total Solids – The sum of dissolved and undissooved constituents in water or wastewater, usually stated in milligrams per liter.

Trade Wastes – The liquid wastes from industrial processes, as distinct from domestic or sanitary wastes.

Trash Rack – A grid or screen placed across a waterway to catch floating debris.

Treated Sewage - Wastewater that has received partial or complete treatment.

Trickling Filter -- A filter consisting of an artificial bed of coarse material, such as broken stone, clinkers, slate, slats, brush, or plastic materials, over which wastewater is distributed or applied in drops, films, or spray from troughs drippers, moving distributors, or fixed nozzles, and through which it trickles to the underdrains, giving opportunity for the formation of zoogleal slimes which clarify and oxidize the wastewater.

Triplex Pump – A reciprocating pump with three single-acting clyinders placed next to each other in line, all connected with the same suction and discharge line, with valves so arranged that the intake and discharge through the pump is continuous.

Turbidity – A condition in water or wastewater caused by the presence of suspended matter, resulting in the scattering and absorption of light rays.

Ultimate Biochemical Oxygen Demand – (1) Commonly, the total quantity of oxygen required to satisfy completely the first-stage biochemical oxygen demand (2) More strictly, the quantity of oxygen required to satisfy completely both the first-stage and the second-stage biochemical oxygen demands.

Undigested Sludge – Settled sludge promptly removed from sedimentation tanks before decomposition has much advanced. Also called raw sludge.

Vacuum Pump – A pump used to create a partial vacuum in a closed space.

Valve – A device installed in a pipeline to control the magnitude and direction of the flow. It consists essentially of a shell and a disk or plug fitted to the shell. See Cock.

Venturi Meter – A differential meter for measuring flow of water or other fluid through closed conduits or pipes, consisting of a venturi tube and one of several proprietary forms of flow-registering devices. The difference in velocity heads between the entrance and the contracted throat is an indication of the rate of flow.

Vertical Pump – (1) A reciprocating pump in which the piston or plunger moves in a vertical direction. (2) A centrifugal pump in which the pump shaft is in a vertical position.

V-Notch Weir – A triangular weir.

Volatile – Capable of being evaporated at relatively low temperatures.

Volatile Acids – Fatty acids containing six or less carbon atoms, which are soluble in water, and which can be steam-distilled at atmospheric pressure. Volatile acids are commonly reported as equivalent to acetic acid.

Volatile Solids – The quantity of solids in water, wastewater, or other liquids, lost on ignition of the dry solids at 600 degrees Centigrade.

Waste–Gas Burner – A device in a wastewater treatment plant for burning the waste gas from a sludge-digestion tank.

Wastewater – The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.

Wastewater Analysis – The determination of chemical composition, concentration, and biological condition of wastewater and treatment effluents.

Wastewater Influent – Wastewater as it enters a wastewater treatment plant or pumping station.

Wastewater Treatment – Any process to which wastewater is subjected in order to remove or alter its objectional constituents and thus render it less offensive or dangerous.

Water Quality – The chemical, physical, and biological characteristics of water with respect to its suitability of a particular purpose. The same water may be of good quality for one purpose or use, and bad for another, depending on its characteristics and the requirements for the particular use.

Weir – (1) A diversion dam. (2) A device that has a crest and some side containment of known geometricshape, such as a V, trapezoid, or rectangle, and is used to measure flow of liquid. The liquid surface is exposed to the atmosphere. Flow is related to upstream height of water above the crest, to position of crest with respect to downstream water surface, and to geometricof the weir opening. See Weir Flow Formulas.

Well – An open shaft of varying depths, may be wet or dry.

Wet Well – A compartment in which a liquid is collected, and to which the suction pipe of a pump is connected.

Y-Strainer – A device designed to remove all particular matter from chlorinator feed water.

Zeta Meter – Electronic measuring device designed to measure the surface electrical charge of colloidal-sized particles.

Zooglea – A jelly-like matrix developed by bacteria. A major part of activated sludge floc and of trickling filter slimes.

Zoogleal Matrix – The floc formed primarily by slime-producing bacteria in the activated sludge process or in biological beds.